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REPORT OF OBSERVATIONS

OF

INJURIOUS INSECTS

AND

COMMON FARM PESTS

DURING THE YEAR 1890,

WITH METHODS OF

PREVENTION AND REMEDY.

FOURTEENTH REPORT.

BY

ELEANOR A. ORMEROD, F. R. MET. SOC., &c.

CONSULTING ENTOMOLOGIST OF THE ROYAL AGRICULTURAL SOCIETY OF ENGLAND, AND HON.
MEMBER OF THE FARMERS' CLUB; HON. AND CORR. MEM. OF ROYAL AG. AND HORT. SOC.,
S. AUSTRALIA; HON. MEM. OF ENT. SOC. OF ONTARIO, AND CORR. MEMBER OF
FIELD NAT. CLUB OF OTTAWA, CANADA; MEMBER OF EASTERN PROVINCE
NATURALISTS' SOC., CAPE COLONY;
ALSO
MEMBER OF THE ASSOCIATION OF OFFICIAL ECONOMIC ENTOMOLOGISTS,
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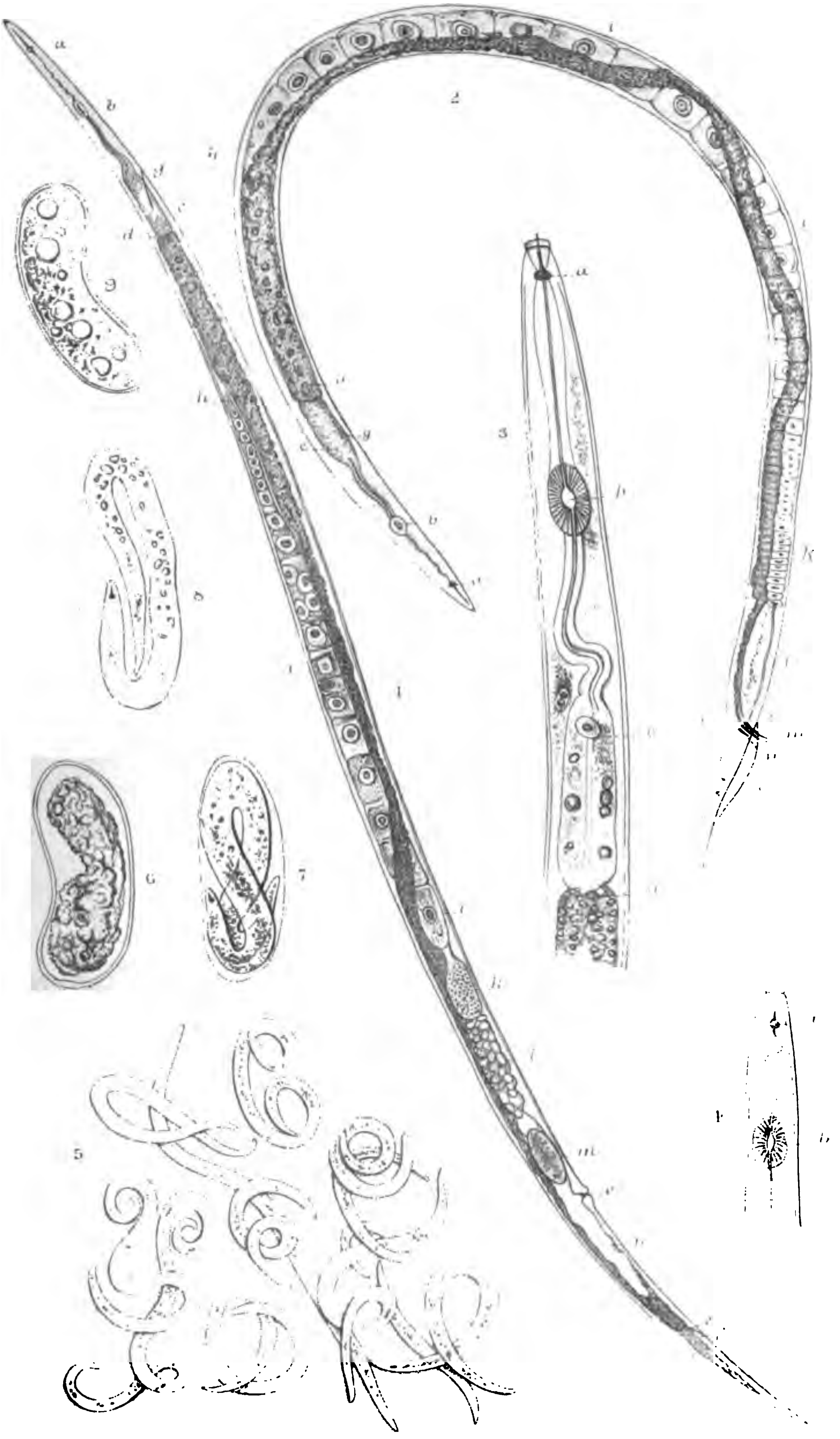

Dr J Ritzema Bos ad nat. del.

[illegible]

Tylenchus devastatrix Kühn.

REPORT OF OBSERVATIONS

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PREFACE.

During the past season of 1890, all, or almost all, of our common crop insect pests were present, and their ravages reported to a greater or lesser extent, but only a few as being seriously injurious, and none as causing wide-spread attack.

Amongst the crop attacks, which for various reasons are the most noticed, that of Hessian Fly has now become distributed at localities over most of the area of England, excepting the most southerly and westerly parts; but at the same time, as far as can be gathered from examination of specimens and from reports sent, the presence of the pest on the individual stalks of Wheat or Barley in the infested fields in the past year was slight, and the damage caused immaterial.

Whether from weather effects of our insular climate; or from autumn Wheat sowing being (when in regular course) after the time of autumn brood of the fly; or, again, from agriculturists being probably (in some cases) at the pains to destroy infested screenings; it is obvious that, after five years of presence in the country, this pest in its acclimatised condition, does not cause nearly as much mischief as other of our corn insects which unfortunately continue to ravage at their pleasure, because we have not yet found the missing link in their life-histories which would show us where and how they lie in our power.

Perhaps the chief among these are the Gout Fly maggot in Barley heads and stalks, and Bulb maggot in young Wheat, caused respectively by *Chlorops* and *Hylemyia* flies. These yearly cause much loss, and until we know where the maggots of the first spend the winter, and of the second spend the summer or autumn, we are without the clue to lead us to thorough preventive measures. This is a point on which observation is greatly needed for the public good.

The attack of Stem Eelworm (*Tylenchus devastatrix*), which some indications have pointed to for several years back as possibly occurring in Bean plants, has now been found to be unmistakeably present there, and stunting the growth to a serious extent.

Another species of Eelworm (*Aphelenchus fragariæ*), hitherto undescribed, has been found to be the cause of destructive malformation in Strawberry plant growth, which even if observed before (which does not appear to have been the case on the scale of regular field attack) has not been recorded. Another somewhat similarly injurious attack to Strawberry plants from yet another kind of Eelworm is being watched; and these observations will be serviceable, by tracing what may have passed as a so-called "blight" to a definite cause, and probably definite cure.

Some of our common insect attacks were reported as severe locally; amongst these were Rust maggots to Carrots, also presence of Mustard Beetle and Mangold leaf maggot; Willow Beetle was seriously injurious. Orchard Moth Caterpillars, where remedial measures were not applied, also caused much loss.

The Mediterranean Flour Moth (*Ephestia kühniella*) has been steadily making good its hold in Wheat mills and stores in various parts of the country, and those who are suffering from it well know the serious loss as well as inconvenience caused by its all-pervading tenancy.

Some attacks were much less reported; amongst these were less enquiry regarding Turnip grub; and Turnip Green Fly also was only moderately reported. "Frit Fly" (*Oscinis frit*), an unusual trouble, of which the maggots did great damage in the bulbs of young Oats, especially in Devon and Cornwall in 1888; and Corn Sawfly (*Cephus pygmæus*), which is a very customary trouble, were hardly mentioned.

In the case of those of our ordinary crop attacks of which the history is now before us all, and preventive measures also up to date fairly well known (for which knowledge, it should be noticed, we are indebted in great part to the observations of our own agriculturists and fruit growers), I have thought it best not to continue to record merely notes of application for information where unaccompanied by any new observation of serviceable interest. Where any fresh information has been contributed, either of history, as in the case of observation of the winter state of *Chlorops* maggot, by Dr. W. Fream; or of a thoroughly practicable manurial treatment, as that to restore Mangold growth after leaf-maggot attack, with which I was favoured from Rothamsted, by kind permission of Sir John B. Lawes; or of notable absence or presence, or any point which may usefully be added to the *well-known* histories, I endeavour to record it. Otherwise, to avoid yearly repetition I am trying to bring forward observations of attacks not hitherto worked out, but which are of practical importance, and (of course) any which have not previously been noticed as present here.

Amongst these new or little noticed infestations, mentioned in my present Report, are the attacks of the American Cloverseed Midge, Mites in Hay, and distorted growth of Tares, and heads of Tares from one or more kinds of insect presence. Also, attacks of Chermes to Apple, and of the caterpillars of the Dot

Moth to Gooseberry and Currant; of those of the Fox-coloured Sawfly to Pine, and the very interesting observation (for which I am indebted to Dr. W. Somerville, Prof. of Forestry in the University of Edinburgh) of attack of our common "Pine Beetle" to Larch. Observations of Eelworm attacks to Bean and to Strawberry plants, and the peculiar malformed growths thence arising, have not been recorded before save in my official reports for the Journal of the Royal Agricultural Society of England, in which importance of space does not allow of full technical entomological details.

Great advance has been made in the past year as to the long-needed point of introduction of treatment which might be brought to bear when occasion called for it, in clearing off the hordes of moth caterpillars, which yearly, with the appearance of the spring leafage, had pretty much at their own pleasure ravaged the trees of our chief orchard growers. As full details of the means employed both for prevention and remedy, respectively, of autumn establishments and of spring injuries will be found under the heads of "Sticky-banding," "Paris-green," &c., it is unnecessary to do more here than to refer to them.

Advance has been made also in methods of applying insecticides, by introductions of new forms, and also by better adaptations of old forms of spraying machines, so that these are now procurable, suited as may be needed for the various requirements of orchard growth crowded by under-cropping, of more open space giving room for use of hand-barrow sprayer with much higher delivery up to 40 or 50 feet; or the Strawsonizer in its different forms for field and orchard use, of which the good report on its many trials as to delivery, both of dust and spray dressings, has been so often before us as to make it great matter of regret that the issue was so long delayed.

That advance has also been made in appreciation (in some of the highest quarters) of the necessity of adding knowledge of prevention of the ravages of crop insect pests to other branches of agricultural education, has been shown by the addition, in the past year, of agricultural entomology as a voluntary subject, to the papers set at the Senior Examination by our Royal Agricultural Society: also by examination on the same subject being now made compulsory at the Royal Agricultural College, Cirencester; and the subject is also receiving attention amongst the points of agricultural education which are especially taken up at the University College of N. Wales, at Bangor.

The endowment of a Lectureship in connection with the Chair of Agriculture in Edinburgh University, named, in remembrance of the liberal foundress, the "Steven Lectureship," has already in its opening course proved another helpful aid in advancement of serviceable knowledge of agricultural entomology. In the well qualified hands of Dr. W. Fream, the course of instruction was throughout based on scientific principles, yet the practical applications of the subject were constantly kept in view. The requisite broad generalisations not being brought forward at first, but gradually worked up to and placed clearly before the agricultural students as the facts on which they were based accumulated, a trustworthy foundation was thus thoroughly impressed on the hearers for future work.

As in former reports it is my duty to offer my grateful thanks for important help afforded me in the past year's work. To our own agricultural press I have always to offer my thanks for valuable co-operation, and I have likewise gratefully to acknowledge the liberal and unceasing donations of successive publications with which I am favoured from Canada and various of our own Colonies, and likewise from the Dept. of Agriculture and Experimental Stations of the United States of America, which thus enable me to have at hand notes of the very latest advance in details bearing on prevention of insect crop and fruit pests.

To some of my kind and skilled fellow-workers my thanks are most especially due. Amongst them to Mr. J. Fletcher, the Dominion Entomologist of Canada, for great help given by his sound and experienced advice regarding application of insecticides for orchard use, and especially of Paris-green. To Dr. J. Ritzema Bos, Prof. of Zoology at the State Agricultural College, Wageningen, Netherlands, I am always indebted for his assistance with regard to identification, and also many other serviceable points regarding the history of nematoid worms, popularly known as Eelworms, which play an important part amongst the microscopic pests of some of our chief crops.

To Mr. Frazer S. Crawford, of Adelaide, S. Australia, whose sound and well-skilled work was so serviceable in his own Colony and so well and so widely known, my tribute of yearly thanks is now (with the regret for his loss shared by his many friends) a tribute also of respect to the memory of an earnest and thoroughly true worker who has passed to his rest. His careful observations, the zeal for the public good with which he was ever on the alert to prevent establishment of dangerous infestations in the Colony, the hearty courtesy and open-mindedness with which all points under discussion were conducted with the co-operators with whom he was in correspondence at home or abroad, make his loss cause of great regret to his colleagues and friends; and with a grateful remembrance of many years' unfailing assistance and co-operation, I desire to add my tribute of deep respect to his memory.

In the following Report, I have as far as possible mentioned the names of my co-operators with the subjects under consideration, but I have especially to acknowledge with many thanks the assistance rendered me by Mr. Oliver E. Janson, F.E.S., of Perth Road, London, N., in identification or comparison of specimens, where I have not the opportunity myself of ascertaining these points with absolute certainty. To my sister also, Miss Georgiana E. Ormerod, F.E.S., I am always indebted for all the aid which constant colleagueship and no small amount of entomological knowledge can give.

The figures at pp. 27, 28 and 134, are given by permission of Messrs. Blackie & Son, Glasgow. Those at pp. 74, 77 and 78, by permission of Messrs. W. H. Allen & Co., London. Those at pp. 11, 113 and 122, from electros of which the use is permitted me for my Annual Reports, by the proprietors of the 'Gardeners' Chronicle.' Other figures which are copied, or in part taken from various entomological sources, are in almost every instance acknowledged accompanying, and the remainder, about 17 in number, have been drawn from life in some instances by myself, but for the most part by Mr. H. Knight, artist to Messrs. West, Newman & Co., London.

During the past season of 1890, in consequence of the heavy work requisite for the preparation of the 2nd Edition of my Manual, and the great injury to my health from the long continued over-pressure, I was not able to devote the time that I much wished to do to tracing out the full history of various attacks. But in the coming season, should moderate health be continued, and I am still favoured with the kind co-operation of my correspondents, I shall hope to give especial attention to investigation, and to be able as before in due season to submit to them again another Report.

ELEANOR A. ORMEROD,

Consulting Entomologist of the Royal Agricultural Society of England.

TORRINGTON HOUSE, ST. ALBAN'S,
February, 1891.

LIST OF

INJURIOUS INSECT AND EELWORM ATTACKS

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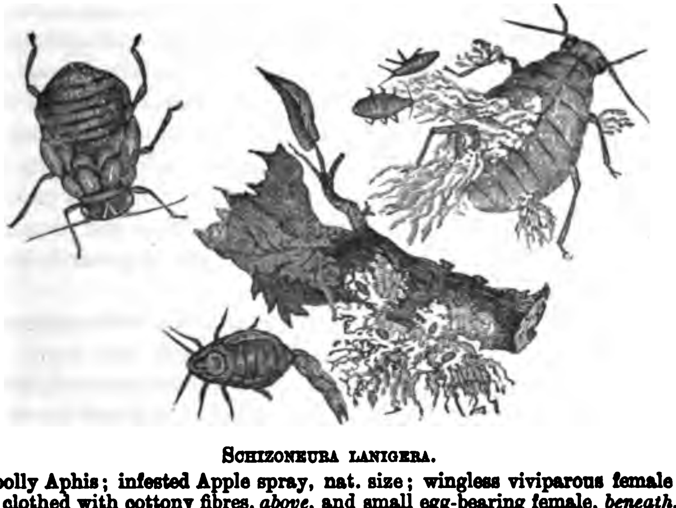
NOTES OF OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON CROP PESTS
DURING 1890.

APPLE.

American Blight; Woolly Aphis. *Schizoneura lanigera*, Hausm.



SCHIZONEURA LANIGERA.

Woolly Aphis; infested Apple spray, nat. size; wingless viviparous female and young clothed with cottony fibres, *above*, and small egg-bearing female, *beneath*, the spray; pupa, with slight cottony growth; all magnified.*

THE American Blight, or Woolly Apple Aphis, is an orchard-pest so widely distributed, and of such old standing, that it has seemed each year too well known to require special mention; but still, as the inquiries that recur show that its history and methods of prevention are not so well known as is desirable, and also the attack itself appears to be at times confused with other infestations, some short account of it may be useful.

---

* The above figure is acknowledged with thanks, as after 1 and 3, plate cv., and 2 and 5, plate cvi., in 'Brit Aphides,' vol. iii., by G. B. Buckton, F.R.S.

The Woolly Apple Aphides are of the shape figured, with six legs, and (when in winged condition) with two pairs of transparent wings; a head furnished with antennæ or horns, and for the most part with a rostrum or sucking-tube, by means of which these insects cause great mischief. This rostrum is of enormous proportionate length in the Aphides when first born, but it is stated to be absent in the egg-laying female. The honey-tubes or cornicles are absent or rudimentary.

The colour differs with condition or sex, but the Aphides may be generally described as of some shade of brown in their older stages, and of warm brown or red or pinkish in their earlier condition. The winged egg-producing female is stated to be yellow, tinged with red. The pupæ are "slightly clothed with down. The insects, when adult, exude from their pores long silky threads, which curve round a centre, and often form long spiral filaments, under which they hide."—G. B. B. This wool sometimes shows merely as a film, like a little white mould in the crannies haunted by the plant lice; sometimes it shows as tufts and patches on the trunk or boughs, or on leaves, or on shoots,—anywhere, in fact, where the insects can establish themselves,—and in neglected gardens and orchards may be seen swinging in long partly detached masses. The existence of the attack may easily be known by the presence of these films or masses of white woolly matter, in which the insects shelter themselves, and the young may be found collected together thus even in severe cold. I have found them sheltered in the cottony material myself during the winter, and Mr. Buckton records finding the wingless larvæ alive and plentiful on Apple branches in December, when snow was on the ground, and the thermometer stood at 21° Fahr.

The mischief is begun by the Aphides inserting their suckers into the soft tissues of the trees, and drawing away the sap. They especially resort to where boughs or twigs have been removed, and the young bark is pressing forward over the wound, or where the outside bark may have been detached so that the Aphides can gain access to the soft surface beneath; and the result of the suction and many punctures is a soft pulpy swollen growth of the woody layers just beneath the bark. As time goes on these growths dry up and die, and crack open, and new colonies of Woolly Aphides, establishing themselves in the cracks, start new attack, and further diseased growth; and so the unhealthy mass continues increasing in size, until a tree which has been suffering from American Blight for several years is easily distinguishable by the knobbed and cankery growths. The attack of the Woolly Aphis is also sometimes to be found on the roots as well as on the branches of Apple trees.

Prevention and Remedies.—One great method of prevention is keeping the trees in such good order that no opportunity is given for the Woolly Aphides to effect a lodgment. For this purpose careful pruning and careful removal of all injured boughs, so as to leave as smooth a surface as possible, is very desirable. Scraping the trunks and larger branches in February, and then removing rough excrescences which would harbour attack in their crannies, has been recommended, the whole surface being well scrubbed afterwards with soft-soap wash.

In 1882, Mr. Malcolm Dunn, writing to me from The Gardens, Dalkeith Palace, N.B., mentioned:—"I find soft-soap an excellent insecticide, wherever it can be applied with safety to the plant; made into a thick lather and applied with a stiff brush to the stems of Apple trees infested with American Blight, it is a certain remedy. In the winter, when the trees are at rest, it may be applied all over the tree, and if the roots are uncovered from the base of the stem onwards as far as it is easy to get at them, and the soft-soap is applied to them also, the treatment will go far to stamp out the pest. Even a thorough soaking of the soil in which the roots run with strong soap-suds, repeated a few times during winter, is a first-rate means of keeping down American Blight. Of course, the soft-soap must not be applied (as above) to green leaves or bark; it is so caustic that it invariably burns them, especially if the sun strikes on the soap; therefore it must be used with caution in summer."

Probably the mixture known in South Australia as "Burford's soft-soap and sulphur compound" would be useful. This consists of soft-soap, to which one-fourth of its weight of sulphur is added—used as a wash for bark at a strength of 1 lb. to 1 gallon of water.

Any greasy or soapy mixtures, or resin mixed warm with fresh oil, or mineral oils used in soft soap, or, in fact, any application that will close up crannies and stifle or poison the Aphides, will be of great service, so long as care is taken that it does not injure the bark, or soak through it to the young tissues beneath.

Tar, which in former days was recommended, has been proved by the experience of late years to be excessively hurtful where it can soak into the bark; where soft-soap wash is to be applied to tender surfaces, it should be raised to boiling-point in the process of mixing to take away the caustic properties.

I have myself found that where there was water supply at command that thoroughly washing down the trees with a good stream sent through a spreader at the end of a hose had an excellent effect. The force and amount of application could thus be varied as needed, and, when the more delicate shoots were cleared, as powerful a stream as possible sent directly *at* the infested spots on the trunk and branches acted thoroughly well in clearing them for some time, and the treatment can be repeated if needed.

The regular washes may also be very serviceably applied *by the help of powerful engines.* On June 23rd, Mr. Thos. Reader, of Old Hay Farm, Brenchley, wrote me:—"I have again been washing all my trees with a mixture per your direction, and have already found them greatly benefited. We use a horse-power machine, finding it impossible to get through the work any other way."

For prevention of American Blight the great points are clean and careful pruning, removal of all rough stumps of boughs or cankery excrescences or torn and injured bark, which may harbour the blight beneath them, and keeping careful watch for the very first signs of appearance of Aphides, which may be easily known by the white wool.

The kinds of applications that will destroy them are endless, and little, if any, additional information has been brought forward (or, indeed, has appeared to be needed) for the last few years as to treatment, excepting, perhaps, as noted by Mr. Reader, the use of horse-power for throwing the applications; but as both in the past and present year some inquiry has been made regarding the attack, and the history has not previously been entered on in this series of Reports, I have given the main points as shortly as possible.

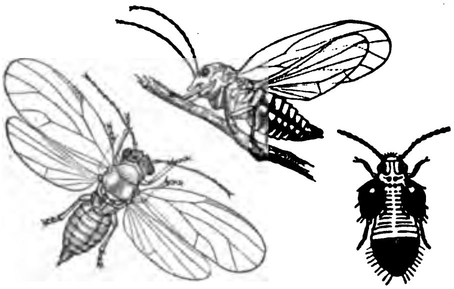
Those who desire to study the history and description of the insect in detail will find excellent information under the head of *Schizoneura lanigera*, in vol. iii. of 'Brit. Aphides,' by G. B. Buckton, F.R.S.; and there is also a long and serviceable paper on this insect by Dr. Cyrus Thomas, in his 3rd Annual Report as State Entomologist of Illinois, U.S.A. The method of formation of diseased growth is given by M. Prillieux, in 'Comptes Rendus' for April, 1875, and in short form from the above paper at p. 789 of the first vol. of the 'Gardeners' Chronicle' for the same year; also in the 2nd Edition of my own 'Manual of Injurious Insects' I give a paper on the American Blight, and means of prevention and remedy from my own observations, and other sources named.

Apple Chermes, or Apple-sucker. *Psylla mali*, Schmidberger.

The *Psylla mali*, the Apple Chermes or Apple-sucker, is a very small insect, usually of a bright green colour, about a twelfth of an inch in length of the body, and scarcely more than an eighth of an inch in length from the head to the tip of the transparent wings, when these are folded as they lie in repose.

The figure on next page shows the Apple-sucker with its wings spread, also raised as in act of taking flight, and likewise the general appearance in the pupal state, with the wings still undevelope

These Chermes or Apple-suckers have the power of doing great mischief by sucking away the juices of the young buds, and (later on in the spring) of the stalks of the blossom or blossom-buds. So far back as 1837 they were noticed in the Trans. of the Imp. and Royal Agricultural Soc. of Vienna as, though commonly causing no great injury, yet that in some years they were very numerous, and, when very numerous, that many blossoms were destroyed by them.



PSYLLA MALI.

"Apple-suckers," from life, with wings expanded, and raised in act of taking flight, mag.; nat. length one-twelfth of an inch. Pupa of Pear-sucker, mag., after Prof. W. Saunders.*

Although they are well known as British insects, I am not aware of there being any published record of observation of their habits, or of notable injury caused by this species in this country, and no mention is made of this infestation amongst the many valuable accounts of insect attacks given in the 'Gardeners' Chronicle,' so far as I can find by search in the forty volumes I have at hand, being from the years 1841 to 1881 inclusive.

The first observations which I received of these Apple-suckers as a seriously injurious attack was sent me early in March by Mr. W. F. Gibbon, of Seaford Grange, Pershore, who followed up the life-history to the peculiar change of colouring, marking complete maturity of the sexes in the autumn, and subsequent egg-laying. And I was also favoured with able coincident observations, with specimens accompanying, by Mr. J. Hiam, of Astwood Bank, Redditch.

In all respects observed the history coincided with that recorded by various German observers, mainly by Schmidberger, who made an especial study of the habits of this insect; and of these I give the main points for comparison with the English observations of last season.

* The figure of the Pear-sucker is given merely to convey a general idea of the appearance of that of the Apple-sucker (which it much resembles) in undeveloped state, as I was unable to secure a specimen of the *P. mali* in pupal state for illustration. The figure is reduced from that at p. 146 of 'Insects Injurious to Fruit,' by Prof. W. Saunders Inspector-General of the Gov. Exp. Farm Stations, Canada.

It is stated by Schmidberger that in September, when the Apple leafage is beginning to turn yellow, the Chermes may be found in little parties of five or six on a leaf, especially on a yellowing leaf. The males are then stated to be of various tints, as of green striped on the back with yellow, or with dark yellow dots, or yellow with brown stripes; the females red along the entire back to the top of the tail, and striped with greenish yellow and brown, the abdomen orange-yellow or green.

After pairing the females leave the foliage, and lay their white spindle-shaped eggs singly, or several together, or sometimes in rows. These may be placed in various parts of the tree, in furrows, or year-old shoots, where there is fine hair. After this the Psyllas, or Apple-suckers, as they are called, die.

It is mentioned by Schmidberger that he never found an egg laid on a leaf. The first eggs were observed by him to hatch about the 5th of April, and the young Apple-suckers, just after hatching, had the body of a dirty yellow, with four dots across the back, the abdomen brown and the extremity dark brown, with whitish hairs. Such as were observed by Schmidberger to come out in the open air, at once betook themselves to the nearest bud, and began to gnaw the scales, and presently penetrated within to shelter themselves from cold and wet. [These points, which are of importance practically, were specially noticed in Mr. Gibbon's observations at Pershore last spring. —Ed.]

After moulting for the first time, Schmidberger noticed that a white transparent tubercle issued from the extremity of the body, which remained attached by a whitish thread, and if removed, another tubercle or round globe and another thread was protruded. On the second moult "the larva not only puts out a thicker string with the tubercle, but also an immense number of very fine entangled threads or small hairs, which it turns upwards over its back, and with them entirely covers its body and head" (Schmidberger).

This strange mass of whitish threads I had an opportunity of seeing myself on specimens under observation about May 22nd.

Later on the rudiments of the wings make their appearance, and for the last change the Chermes fixes itself firmly, the skin splits, and the winged insect steps out from the cast-skin. The time that elapsed from hatching out of the egg to complete development was considered to be about four weeks. The date of appearance of the perfect insect in the open air is given as from the earlier part of May to the beginning of June.*

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* See "Naturgeschichte der schädlichen Insecten, von Vincenz Kollar," in 'Verhandl. der k. k. Landwirthschaft-Gesellschaft in Wien,' 1837; also in English translation of above known as Kollar's 'Insects,' 1840.

The first observation of this insect was sent me on the 10th March, by Mr. W. F. Gibbon, of Seaford Grange, Pershore, in which he mentioned the insect as one which, although "almost unrecognised and certainly little mentioned," was the cause of great destruction to the Apple crop, and further observed:—"The presence of the *Psylla* on the Apple is always indicated by small, opaque, saccharine globules (vulgarly named 'honeydew') in and about the stalks of unopened flower-buds; and, if such a sprout be plucked apart, the young, flat, inert, wingless insect will be found in numbers sucking the juices of the stems of the blossoms. The flower buds, being deprived of their sap, shrivel up, and no Apples are produced, and the insect, casting its skin, appears in a short time in quite a different form,—light green, with transparent wings, active in habit, and leaping all about the tree."

Mr. Gibbon further noted, in comparing the effects of this and other Apple tree infestation, that the *Psylla* attacks the bloom buds, and completes its ravages before it can be noticed by the casual observer, sapping the stems of the blossoms before becoming expanded. Likewise that it harbours itself in the trees most crowded with growth; "consequently keeping the trees open is of importance, admitting, at the same time, the free access of birds to prey upon the insects."

On May 15th, Mr. Gibbon, after intermediate observations, forwarded me specimens in more advanced state; and a few days later I had the opportunity of myself seeing the protective covering of long and confused fine hair-like matter thus described by Schmidberger:—"The second changing of the skin can sometimes scarcely be seen at all, because the larva not only puts out a thicker string with the tubercle, but also an immense number of very fine entangled threads or small hairs, which it twines upwards over its back, and with them entirely covers its body and head." This covering was extremely noticeable, and in course of observations the ball and string mentioned at p. 6 was to be seen.

Later on, in reply to some inquiries as to these excrescences, Mr. Hiam wrote me that these excretions were perfectly well known to him, and, when looked at closely, had a purplish metallic shade on them. This agrees with Schmidberger's observation, that before complete development there is an appearance accompanying the ball and thread of numerous fine curly little hairs of a *light blue varying colour*, with which the abdomen becomes completely surrounded.

Corresponding in date of appearance with the above observations, Mr. J. Hiam, of Astwood Bank, near Redditch, sent me, on April 11th, information of damage to his Apple blossom from an insect which Mr. Gibbon, of Pershore, named as the *Psylla* then under observation; and of this Mr. Hiam remarked:—"I hardly know which is the worst enemy, Chermes, caterpillar, or Aphis. I enclose some, as they are just hatching and crawling inside the buds in large quantities."

Later on—on July 4th—Mr. Hiam forwarded me some specimens of the fully-developed *Psylla*, remarking, regarding previous observation of the pest:—"Although I have recently seen a reference to the *Psylla* being a new pest, I have been well acquainted with the insect as long as I can remember on our Apple trees." And on July 7th Mr. Hiam further forwarded me a spray of Apple tree which has been injured by *Psylla*, showing how the bloom dies away without setting into fruit, and with this more specimens of the fully-developed Chermes or *Psylla*, thus enabling us to prove that the insects watched so carefully through their early stages from the commencement of the infestation were quite certainly the *Psylla mali* of Schmidberger.

To make quite sure beyond any doubt of this, I placed some of the specimens in the hands of Mr. Oliver E. Janson, F.E.S., of Perth Road, London, N., who favoured me with the following reply:—"Your determination of the *Psylla* as the *mali*, Schmid., appears to me to be quite correct. I have compared them with the specimens in the British Museum, which includes the types of the late Mr. John Scott's Monograph of *Psyllidæ* (Trans. Ent. Soc. Lond., 1876), and can find no difference. The bright green colour is similar to those which Mr. Scott separated in his monograph as a doubtfully distinct species, and named *viridissima*, but afterwards united it as a synonym of *mali*." —O. E. J.*

These Psyllas or Apple-suckers, I found, could run very well, and then, with a sudden skip, fly away. Their length somewhat under the eighth of an inch. The general colour apple-green, with the markings, as far as observable, of a pale yellow or yellowish green. These were somewhat variable, but might be described as one central patch on the fore part of the thorax (or body between the wings), two patches or marks on the succeeding part, and narrow cross stripes on the abdomen. Eyes in some cases pale, with the chief part reddish; in others white, with a central black spot, looking, as described by Schmidberger, like a black pupil.

The colours appeared to vary after death, as I noticed one specimen with a greyish band on the upper surface of the base of the abdomen. The antennæ were yellowish, dark towards the extremity, which was furnished with two setæ or small bristles; wings yellowish; legs pale, tarsi pale brownish, or tips of joints and tip of tibia dark.

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* In the 'Catalogue of British Hemiptera,' by Edward Saunders, F.L.S., and James Edwards, F.E.S., 1890, the following synonyms are given for *P. mali*, Schmid.:—*ulmi*, Först.; *cratægicola*, Först.; *viridissima*, Scott; *occulta*, Först. Dr. Franz Low, in his notes, 'Zur Systimatik den Psylloden, Wien,' also mentions as synonyms *æruginosa*, Först.; *rubida*, M. D.; and *claripennis*, M. D. This great amount of synonyms, which still does not include all that have been given to this one species, points to its variation in appearance, and variety of plants which it infests, and is further desirable to note for scientific reference.—Ed.

On the 11th of September, Mr. Gibbon kindly sent from Pershore some specimens of the mature insect, then undergoing the change of colouring which accompanies pairing (quaintly described by Schmidberger as the wedding dress), with the remark, "The matured insect you will find in various forms and colours—some red from head to tail, some only red about the head and shoulders, some quite green, and some milky white."—(W. F. G.)

These winged Psyllas, or Apple-suckers, I found, as described by Mr. Gibbon, to be very various in colour; as green with yellowish patches on the thorax, and paler transverse lines or rings of pale colour on the abdomen; green, with the markings on the thorax of a redder tint, and a little red patching above the abdomen in addition to the pale lines; and pale yellowish, with a tint varying from red to brown along the top of the insect from the head to the tip of the tail inclusive.

At the same date, namely, Sept. 11th, Mr. Gibbon observed, "I have been watching daily to note the date of the laying of eggs, but I have seen none as yet"; but on Sept. 18th I was favoured by him with a little packet of twigs with "freshly laid eggs of the *Psylla mali.*"

The eggs were scattered singly or a very few together, in furrows or protective hollows near the ends of shoots, and were whitish and spindle-shaped for the most part, some more obtuse and yellower. This was observed with a common hand magnifier. In a length of about an inch of shoot I counted (approximately) fourteen or more eggs. And on the 24th of September (thus completing the parallel observations at Redditch and Pershore) specimens of *Psylla* in the reddened tint of maturity, and on a *yellowing* Apple leaf, were sent me by Mr. Hiam.

In the course of the season Mr. C. Lee Campbell, of Glewstone Court, near Ross, also informed me that the attack had occurred badly to his trees.

From comparison of the observations given it will be seen how well these agree with the records of the Continental observers. The Apple-suckers in both cases are found, in the bright colours of maturity, in the earlier part of September; and this is followed by the white spindle-shaped eggs being laid in furrows or protective depressions of the surface, near the end of the shoots. In spring the newly hatched insects were to be found attacking the buds, and likewise seriously injuring the stems of the blossom buds; and our attack was watched onwards through the stages in which the insect is often to be seen, with a white ball appended by a thread to it, and also beneath a covering of light hair-like excreted matter, up to perfect development.

But here we come on a very curious point, to which attention was drawn by Dr. E. L. Taschenberg. *Is there a summer brood?* Although in the case of Schmidberger's observation the Apple-suckers were developed in the first fortnight in May, nothing was noticed of egg-laying until September. In our case the perfect insects were not observable until early in July, which brings the dates of the first appearance and the reproduction nearer; but while on one hand it is curious and unusual that pairing and egg-laying should be so long delayed, on the other, even under the close attention paid by the observers, we have no record of appearance of the Apple-suckers in the young state, nor of observation of the change of colour so eminently noticeable at the September date of pairing preceding egg-laying. Various specimens of young insects were sent me for inspection; but where I was able to examine all details, these differed in material points from the young of Psyllas, and minutely resembled that of the pupæ of a species of *Eupteryx* or "Frog Fly," of which a figure is given in both 1st and 2nd Editions of my Manual of Injurious Insects.

Prevention and Remedies.—Many of the eggs which have been laid near the ends of the twigs may be removed in winter pruning, and it would be desirable to destroy the prunings, or at least to take them well away from the neighbourhood of the trees, lest by any possibility the young Apple-suckers should creep up the trunks.

As they feed by driving their suckers into the soft tissues it is not likely that poisonous washes will have much effect upon them, and caustic applications if used at a strength to kill the insects, would probably also kill the tender tissues, such as the buds or young stalks from which they were drawing their food.

Where the young Apple-suckers are numerous enough to be causing real mischief *and are accessible*, probably the best remedy would be soft-soap wash with some addition of sulphur, or of quassia, or tobacco; but there is sometimes a difficulty in getting at them.

Mr. Hiam mentioned, "I have used insecticides with little effect, on account of their habit of secluding between the stems of the Apple bloom in the cluster or truss. I am using an old umbrella daubed or painted with the tree dressing inside with considerable effect, as the insects fly out and are caught when the tree is shaken or disturbed."

The above plan appears very practicable and might be acted on in an enlarged form, by putting tarred cloth beneath the trees, and shaking down on a broad scale.*

The observation of Mr. Gibbon, that the attack was most present where the boughs of the trees were crowded, is well worth notice. Though this attack has not been brought forward before as causing mischief in this country, there is good reason to think that it has been present, and it would be well in the spring, towards the end of April, to watch for its appearance in its early stages, in order to counteract its effects and check its increase.

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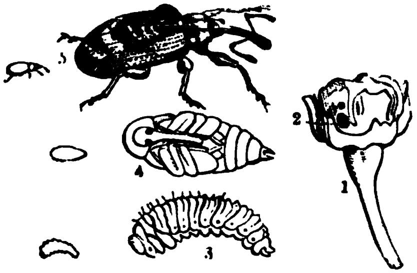
* For recipes for soft-soap washes, see Index.

Apple-blossom Weevil. *Anthonomus pomorum*, Curtis.



1 and 2, Apple-bud pierced by weevil; 3, maggot; 4, pupa; 5, weevil; all magnified with figures showing nat. size.

The Apple-blossom Weevil figured above, is a small long-snouted beetle, of a reddish brown colour, with various paler stripes and spots, and a pitchy-coloured patch on the wing-cases, with a pale stripe on it. The female beetle does much harm in some seasons, by boring a hole into the unopened flower buds of the Apple (and in a lesser degree of the Pear) with her proboscis, and laying one egg successively in unopened flower buds until her supply is exhausted. The maggots from these eggs feed each within its own flower bud, which therefore, instead of expanding, turns brown and dies, and the maggot presently changes, within the destroyed bud, to a chrysalis of the shape figured above and of some shade of ochry colour, and thence to the perfect beetle. These are said to remain throughout the summer on the fruit trees, where they feed on the leaves. "They are very shy and precipitate themselves to the ground as soon as they are approached."—(Schmidberger).

This is one of the regular old standing orchard attacks, which appear more or less every year. In some years it is very injurious, the amount of mischief in some degree depending on the season, because the beetle does not lay after the flower bud has begun to open, so that in a warm sunny season when the buds form and open quickly the female beetle, whose laying operations are very slow, has them cut short before completion by the buds having ceased to be in a state for laying in.

One important point brought forward by the observations of the past season as to the habits of this insect is how far the female beetle may be considered to reach the buds by flying rather than (as has been believed to be the case by some of our very best observers) by crawling or creeping along the boughs.

In the life-history of this insect given by John Curtis, he says, "In March when the flower buds are swelling, the beetles emerge from their retreats, when the males are seen in sunny mornings flying amongst the trees in search of the females, who generally are crawling over the branches, although they are also furnished with wings." And again, in the same paper, John Curtis says, "From various statements it seems that the females will not readily fly, and as they crawl up the trees their incursions may be stopped, and the crops saved, by winding tarred bandages round the upper portion of the trunks." *

It is also mentioned by Schmidberger (see Kollar's 'Insects') that, "The female beetle generally walks from one bud to another; nor are these insects often seen flying from branch to branch." Dr. Taschenberg mentions that they creep or fly.

Regarding this point, Mr. H. C. Staples wrote me the following observations from Swanley, Kent, on the 2nd of April, at which time he remarked that the blossom buds were becoming visible in some of the earliest trees.

"The Apple-blossom Weevil is now very active and plentiful; it is useless to dress the stems of the trees as this insect seems to fly as readily as any other. I have tried syringing the trees with arsenic in water, with soft-soap in water, and with paraffin in water, spreading paper beneath to see if any dead insects fall; only the last-named seems of any use, and that not in a very marked manner."

As the powers of flight of the female Apple-blossom Weevils, or at least their disposition to use them, are a very important consideration in arrangements as to prevention of attack, I suggested to Mr. Staples that it would be serviceable if he would make quite sure whether the specimens which he saw on the wing were females, by examining whether they contained eggs; and later on in the month (on the 25th) Mr. Staples reported, "I have killed several with wings which I have found to contain little creamy-white eggs, which, if magnified to the size of a Mustard seed, show a minute black spot on one side."

I did not see the eggs myself; but the description of the egg by Dr. Taschenberg is also as being white (without mention of appearance when magnified).

It would be very desirable if orchard growers during the coming spring would look further into this matter. It may be that as the weevils are very susceptible of weather influence, the females only fly when

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* See 'Gardeners' Chron.' for 1844, p. 556.

the weather is very warm; but thorough observation as to what is the *prevailing* habit, and whether it depends on state of weather, is needed relatively to whether sticky banding, on first appearance of the weevils, is worth the cost or not.

The following notes show the presence of the infestation in different parts of the country, with one estimate of proportion of blossoms injured, and some suggestions of very practicable method of destruction of the weevils before maturity, thus lessening amount of future attack.

On the 2nd of June, Mr. John Watkins (fruit-grower near Hereford) wrote me:—"I send a small box containing Apple blossoms, which are infested with a small white maggot or grub. I have been giving a good deal of attention to fruit-tree pests, but this is the first season I have noticed these. On pulling off the brown withered blossom you will mostly find one, in some stage or other, in the centre. Some of the trees have a large proportion of the blossoms affected." The box contained about fifty destroyed Apple-blossom buds, with the brown withered petals, instead of being expanded, forming a covering to the calyx and ruined centre of the flower, in which lay, in many cases, the *A. pomorum*, now in chrysalis state, and clearly showing the very long proboscis and dark eyes.

On June 4th, I had a note sent by Mr. Alex. Fairweather, from Wormshill, near Sittingbourne, Kent, mentioning that on examining the Apple bloom on the previous day he had found caterpillars quite enclosed in the dead blossom, lying at the bottom of the stamens, and in different stages of development (with lateral limbs like incipient wings). This attack also was obviously (from the details given) caused by the maggots of the Apple-blossom Weevil.

On the 6th of June, Mr. Staples sent me specimens of the Apple-blossom Weevil, with the remark that the small maggots so destructive to Apple blossom, "the prevention of which is now engaging so much public attention," were then turning to the little beetle of which he sent samples.

On the 16th of June, Mr. Hiam, of Astwood Bank, near Redditch, alluding to some Apple Weevil he had sent me a few days before, observed:—"These have been very destructive in the grub stage, eating all the inside out of Apple and Pear blooms, and causing them to fall off. I do not think I should exaggerate if I said they destroyed 25 per cent. of my blooms."

As a means of lessening amount of future attack, I suggested shaking down the blighted buds which contained the weevil in its grub or chrysalis state and destroying them. Mr. Hiam replied, "I have tried the plan you mention, and find it answers very well for what few affected bloom buds there are left on the trees, but have no doubt it would have been much more successful in catching the bulk of the weevils if it had been attended to a fortnight ago in the case of Apple bloom, and a month ago for Pears."

The above observations of date of the weevil attack, show the beetles to have been very active and plentiful by the 2nd of April, when the earlier Apple-blossom buds were beginning to show, and eggs to be found in the females later on in the month. Then there was a lull in the observations after the weevils doing the mischief had ceased to be noticeable, until the results of their work became observable at the beginning of June in the numbers of brown, and destroyed, blossom buds, with the beetles in chrysalis state within, from which I had specimens of the beetle sent on the 6th and as late as about the 12th of June.

PREVENTION AND REMEDIES.—One good method of prevention which has long been known is to clear away from beneath the trees clods and stones, and bits of wood, or rubbish of any kind which might shelter the beetle during the winter. Also to keep the bark in such a condition that there shall be no shelter for the beetles in crannies or under broken pieces. But the plan of getting rid of the pest "wholesale," as may be done by shaking it down in embryo, in the destroyed buds, does not seem to have been much brought forward.

Schmidberger noticed that where there were only dwarf trees in a garden, picking off the infested buds before they turned brown, that is, before the chrysalis was formed, answered perfectly and completely in preventing infestation for years; but he did not allude to possibility of *shaking* down the destroyed buds, which would make the clearance applicable to larger trees.

So far as last year's experiments showed, the plan would answer by taking the time early in June, when the effects of the attack were so far advanced that many of the infested buds might be shaken down, but still the chrysalids within would not have completed their change to beetle state. This plan would be well worth following up as far as possible next year, and reporting on as to how far the buds out of reach can be made to fall by jarring. Of course they should be shaken down on cloths, and all that falls burnt, or the chrysalids would mature in the buds as well below as on the trees.

The ordinary remedies of sticky banding, in case the beetles are found to be creeping up the trees, or of jarring to throw them down, are well known. In the latter case cloths smeared with something sticky should be spread below to prevent them getting away; or a hand apparatus, made simply of a piece of stout muslin or light cloth about two yards square, kept firm by a wooden rod or lath at each end, and one running lengthways and fastened to the centre of each end bar by way of a handle, would be useful. The handle or centre bar is only used to connect the bar at each end, not fastened to the muslin, which is rather longer, and therefore hangs a little loosely below, so that the beetles can be shaken together and poured out into a pail to be destroyed; or the cloth may be stretched tight, and tarred, so as to catch the vermin as they fall. This kind of hand apparatus is found useful in American orchard insect prevention.

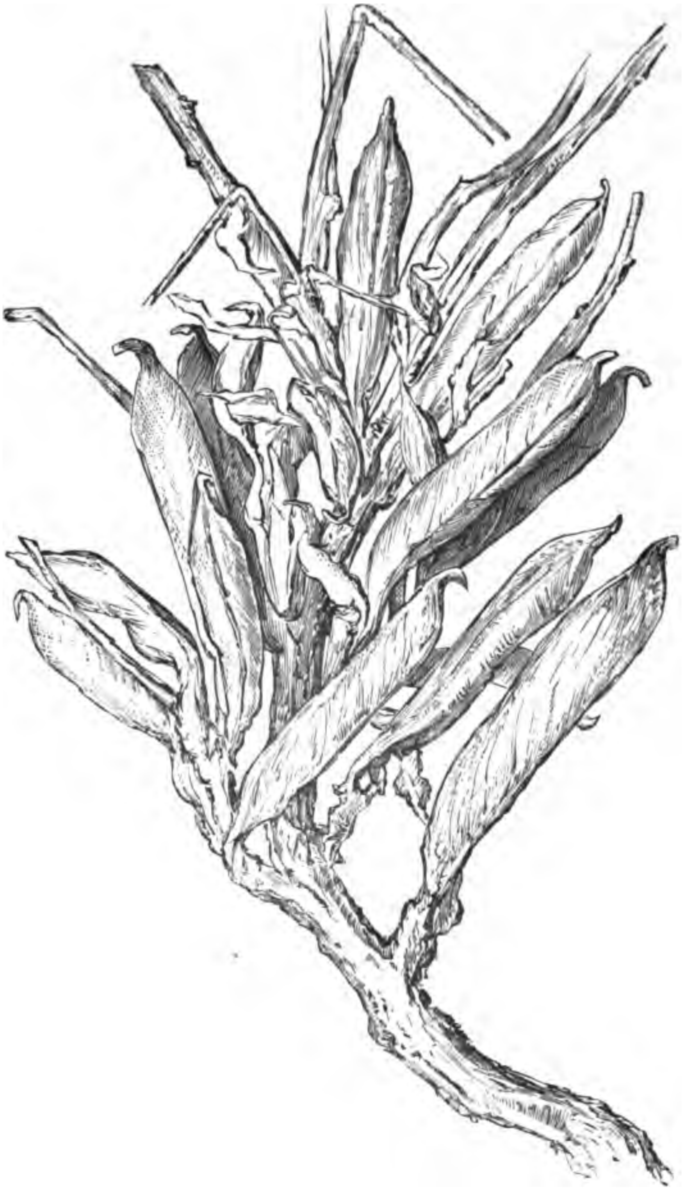
Anything deterrent, such as common whitewash with a little paraffin in it, or soft-soap with a little paraffin or sulphur added, and well applied to stems and branches, would be likely to be of some service in keeping off attack; but probably the best method of all for lessening amount of beetles would be destroying them in young state in the destroyed buds.

Winter Moth.—Observations regarding the Winter Moth (*Cheimatobia brumata*), the caterpillars of which are amongst the worst infestations which we have to Apple as well as to Plum foliage in the spring and early summer, are placed under the latter heading, because it was mainly on Plum trees that the trials of the effects of applications of Paris-green sprayings (which proved so satisfactory in their results) were made by the members of the Evesham Experimental Fruit Conference in the past year.

The position and date of egg-laying, also description of appearance of eggs, and other matters of serviceable interest regarding history and means of prevention of Winter Moth, will be found under the same heading.

BEANS.

Stem Eelworm. *Tylenchus devastatrix*, Kuhn.



Field Bean plant infested by *Tylenchus devastatrix*; nat. length, including curve of stem, about 10 in,

The opposite figure is from a sketch taken by myself of the whole of a plant of Field Beans, stunted and deformed by presence of the *Tylenchus devastatrix*, the Stem Eelworm (well known as the cause of "Tulip-root" in Oats, and "Stem-sickness" in Clover), so that the whole plant was only about ten inches high by five inches wide.

Up to this observation of 1890 of the deformed growth of the Bean plants in the field from which the specimens sent me were taken, there has been (as far as I am aware) no record of this attack being found to affect the Field Bean, that is to say, no record of the Stem Eelworm, the *T. devastatrix*, being found, on skilled examination, to be present in the stunted and deformed Bean plants.

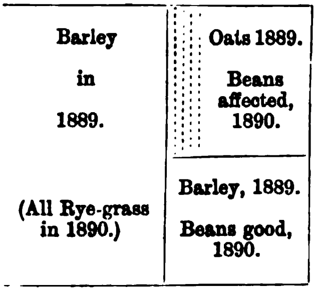
In 1886, information was sent me by Mr. Drennan, of Goatfoot Farm, Galston, Ayrshire, that for several years he had sowed Beans as part of the green crop, and had found Tulip-root to be much worse on the plot where the Beans were, so he gave up sowing them, and, although the land had gone through a course of cropping, the Beaned plots were still worse than the other portions of the field.

Mr. Drennan forwarded me some stumps of Bean plants from land where Tulip-root had been bad in the previous year, and these I examined carefully for presence of Tulip-root Eelworms, but could find none. This, however, was easily accounted for, as the plants had been manured with a mixture containing sulphate of potash, which we have since found to be an excellent preventive or remedy of the Stem Eelworm.

In the same year—in the report of the condition of the Oat crops at the Highland and Agricultural Society's Experimental Station at Pumpherston—it was noted that the crop that season was Oats after Beans, and, in common with many fields under Oats, had suffered considerably, and Tulip-root was somewhat prevalent. Here, however, excessive drought was considered to be doing mischief.

In 1887, Mr. Drennan again forwarded me Beans and Oat plants from a locality which had suffered seriously from Tulip-root "for a number of years," and on examination, at my request, Dr. Ritzema Bos found the *Tylenchus* in the Oats, but *none* in the Beans.

No further notes were sent me on this special point until the 8th of August of the past season (1890), when Mr. J. R. Eve, Estate Agent, &c., of Luton and Hitchin, wrote me that on the previous day he had seen a case which he wished to report for consideration. He mentioned:—"I was valuing crops in this county, and on reaching a piece of Beans noticed a very marked difference, and that a portion of the crop had been more than half destroyed. The bailiff told me the Beans had been failing since before the time they came into flower, and that the destruction had been going on ever since. But the remarkable part is this, shown in the sketch accompanying this letter, *viz.*, that where the Beans are affected they followed *Oats* last year, and that the evil ceases immediately where Barley was grown last harvest. There is still another mystery; the four rows (shown by dotted lines) by the side of the injured Beans are quite perfect, and Barley grew in 1889 by the side of these. I suggested to the bailiff whether the Beans were planted exactly at the boundary of the Oats, or whether they encroached somewhat on the Barley stubble; but he speaks with great confidence that this was not the case."



On examining the Bean stems I found Eelworms present in the rough or powdery matter within. These were few in number, and at first appeared, excepting in one doubtful instance, to be dead, or at least wholly motionless. After soaking in water, however, one became active, and I could clearly distinguish a spear with a bulbous base, and, so far as I could ascertain, it was the species *Tylenchus devastatrix.*

As it was very important to be quite certain as to the nature of the Eelworms, both with regard to damage to the Bean crops, and also with regard to rotation of crops on infested land, I forwarded specimens to the skilled examination of Dr. J. Ritzema Bos, of Wageningen, Holland, who wrote me as follows:—

"I examined the Bean stems, and, exactly as you wrote to me, I found in the inner blackish mass a great number of Eelworms. They were all in a lethargic condition. By damping them in water most of them recovered. The earliest were a pair of Eelworms without a spear. The next—or, at least, almost the next—to revive slowly had all a spear, and all the characteristics of *Tylenchus devastatrix.*"

Dr. Ritzema Bos further added that all the reviving Eelworms were larvæ, and all possessed a spear, but that in this genus of Nematodes we cannot quite completely determine the species whilst they are still in larval state. He further added that amongst the crumpled-together Nematodes which had not revived he found one female which possessed a spear, which, it was tolerably apparent, was *T. devastatrix*, for the absolute and relative measurements agreed with those of females of this species; but up to this date no males were noticeable, which are needed for right determination of the species. Therefore I sent a further supply of diseased Bean plants, in which, as will be seen by the report of Dr. Ritzema Bos, given after my own description and measurements of these diseased plants immediately following, the male was present, and thus (through the skilled examination we were favoured with) we have certain knowledge of the presence of the

T. devastatrix in its various conditions of male, female, and larvæ in the stunted and deformed Bean plants.

These specimens, which were all mature, were sent me by request of Mr. Eve, from the Tingrith Manor Farm, near Woburn, Bedfordshire, shortly after the 12th of August. On carefully examining the six plants sent me, I found one plant to be not as much as four inches high, the stem flattened and widened, and swelled at the base, where it was evidently broken off at ground-level.

Two others of the plants were only about ten inches high. Of these one was fairly healthy in form, the other had eight side shoots from six inches length of main stem; these so placed that the whole plant, with its shoots and pods, had a kind of oval fan-shape, as shown in the figure at the head of this paper. Some of the pods were straight and rightly shaped, but a large proportion of them were stunted and distorted, and some of them were scarcely as much as three-quarters of an inch in length. The lower part of the thickened stem was much curved, and in the case of another of the plants the stem was so much curved just at ground-level that (although it was altogether scarcely more than twelve inches high) about three inches of the length was nearly horizontal. Another of the plants sent me was also slightly swelled and deformed, and very much shortened in growth.

The sixth plant was fairly healthy, and served as a kind of scale to give some idea of the amount of harm that had happened to the injured specimens; in this case the stem was over three feet and a half in length.

On forwarding some of the Bean plants to Dr. Ritzema Bos, he made examination and found the male, which possesses a bursa. Therefore, as Dr. R. Bos wrote, "the Eelworm which infests the Beans is a *Tylenchus*"; and further, "the dimensions of the various parts of the body, the relation between the length and the breadth, and the absolute length of the Eelworms, are such that I have no doubt at all *that the Eelworm which infests the Beans is (just as you supposed) Tylenchus devastatrix*."—J. R. B.

This Stem Eelworm (the *Tylenchus devastatrix* scientifically) is a minute transparent-white threadworm, at its full growth scarcely more than 1-25th of an inch in length, and its greatest breadth may be said in a general way to be 1-30th of its length. The full microscopic details are given under "Tulip-root," together with a full-page plate of the male and female Eelworm, after drawings by Dr. Ritzema Bos, Professor at the Royal Agricultural College, Wageningen, Holland; but the above general statement of measurement is also desirable to notice, because an entirely different kind of small white worm, often to be found near the roots of plants, which, though very minute, are yet quite large enough to be seen by the unassisted eye, are often mistaken for the Stem Eelworms.

Other kinds of true Eelworms, probably all harmless, may be present, but with good microscopic powers the *T. devastatrix* will be seen to have in the gullet (œsophagus) a sharp point known as the "spear" set on a bulbous base, which in the Tylenchi is 3-lobed; this is some assistance in identification, though the species cannot be thoroughly identified without examination of the male Eelworm for the presence of a *bursa* or purse near the caudal extremity. Very few but specialists can identify these minute threadworms trustworthily, but in Tulip-root, and in the peculiar growths of Clover in "Stem-sickness," and now in the peculiar deformed growth of Field Beans caused by this infestation, we have the plain outward signs of what is the cause of mischief within so clearly noticeable that for serviceable practical purposes constant microscopic investigation is quite unnecessary. These Eelworms propagate by laying eggs, and may be found in the infested plants in all conditions, that is, as larvæ, and also as males and females.

Prevention and Remedies.—As we have only known certainly towards the end of the past season of the existence of this infestation in Field Bean plants, it is impossible to say yet what treatment will succeed; but it may fairly be supposed that just the same applications will do good which have proved thoroughly serviceable in checking the same kind of attack in Clover and Oats.

For Clover a mixture of sulphate of potash 3 cwt. and sulphate of ammonia 1 cwt. per acre was found, at Rothamstead, to act thoroughly well. Sulphate of iron, at the rate of 2 cwt. the acre, also answered very well; but at the rate of 1 cwt. was not so successful.

A mixture of sulphate of ammonia 4 parts, sulphate of potash 1 part, and steamed bones 2 parts, given at the rate of 1½ cwt. per acre, followed up by a dressing of 2 cwt. per acre of sulphate of ammonia, has been found to act well as a dressing for Tulip-rooted Oats or Stem-sick Clover.

A mixture of sulphate of potash 2 parts, sulphate of ammonia 3 parts, together with 4 parts of phosphates, has given very good results, and a mere top-dressing of sulphate of potash at the rate of about 1 cwt. per acre has been reported as checking the Eelworm (Tulip-root) attack in Oats, so that an excellent crop was cut.

Methods of prevention have been fully entered on in detail before,* so that it is only necessary just to allude to them. Many of the

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* See 'Reports on Injurious Insects' for 1886—1889, and 2nd Edition of 'Manual of Injurious Insects,' also by E. A. Ormerod, Messrs. Simpkin, Marshall, Hamilton, Kent & Co., Stationers' Hall Court, London, E.C.

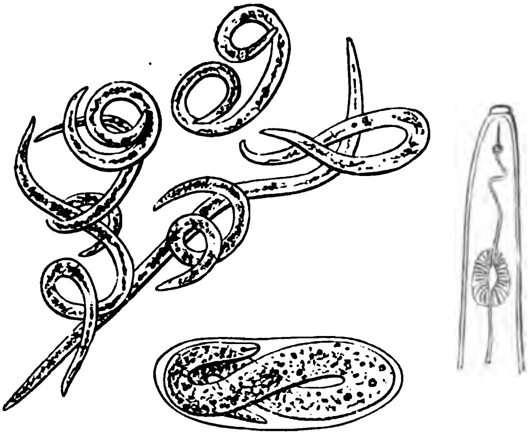
Eelworms leave the plants, and remain in the upper part of the land; therefore preventive measures consist first and most importantly in a rotation that does not give one kind of crop notably liable to Eelworm attack to immediately follow a crop obviously infested. Thus Oats should not follow Stem-sick Clover, nor Clover, Tulip-rooted Oats; and now we find that Field Beans require attention as to their powers (as a general thing) of taking the infestation. Potatoes also are liable to attack of *Tylenchus devastatrix*, but it has not been as yet reported as present here.

The Eelworms are *not* necessarily destroyed by processes of digestion, so that the very same Eelworms which were taken off the field in infested straw, &c., for fodder, may be returned to it in manure.

Very deep ploughing, or ploughing with a skim-coulter, or (where only small patches of a few yards have to be dealt with) trenching so as to turn down the top spit, are good mechanical measures of treatment.

CLOVER.

Stem Eelworm. *Tylenchus devastatrix*, Kuhn.*



Stem Eelworm (*Tylenchus devastatrix*); anterior portion of female showing mouth-spear; and embryo in egg; all greatly magnified (anterior portion mag. 440 times). From figures by Dr. J. Ritzema Bos.

Only a few observations on Clover Stem-sickness, caused by the attack of the Stem Eelworm, have been sent in the past season. From these I give the following description of infested plants sent to me in July by Mr. J. R. Eve, of St. Paul's Square, Bedford, as I found the diseased growth to be most markedly present.

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* The above wood engraving is merely given to save reference as to general appearance. For highly magnified figures of male and female *Tylenchus devastatrix*, together with figure of eggs and other details, the reader is referred, as before mentioned, to plate accompanying paper on "Tulip-root."

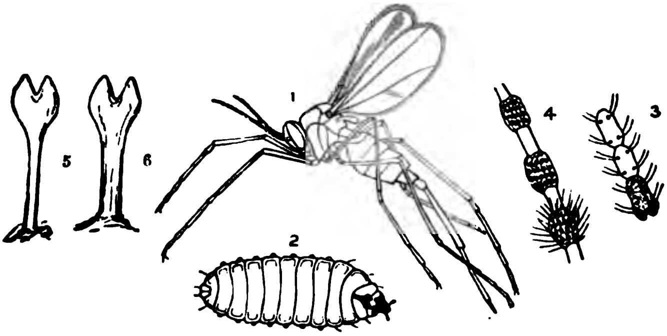
On the 8th of July, Mr. Eve wrote me to inquire the cause of the Clover plants in the fields dying off, "blind specimens" of which he sent at the same time. He also noted that "for the last three months the Clover had been getting less and less." The term of "blind specimens" very well described the condition of the plants. The flowering stems were shortened, and down at the root, or rather above ground-level, were the thickened buds so characteristic of *T. devastatrix* attack. In one case there was quite an aggregation of these at the summit of the tap root; two shoots only had pressed on in a fairly normal state. About three others were stunted to about an inch in length, forming masses of thick, short, elongated buds, or swelled shoots. One of these had thrown out one shoot about an inch and a half long, with a characteristic swelled leaf bud near the end. There were also so many other distorted small buds on this plant as to make a thick mass at the top of the main root, and on one of the moderately healthy but shortened stems there was also a small hard bud at the axil of the leaf.

The attack was so bad that Mr. Eve mentioned there was no intention of attempting to save the crop, as there was not one acre out of twelve where Clover could be seen.

Amongst the other observations the only one referring to large presence of this infestation in a district was sent me from Alford, Lincolnshire, on the 6th of July, by Mr. Eardly Mason, who reported that many complaints of the Red Clover going away had been made to him, and the special attack which he had been able to examine "was certainly due to this plague." Information was also sent me of good success of treatment previously advised.

A short description of the Stem Eelworm, the *Tylenchus devastatrix*, and methods of treatment found thoroughly serviceable in checking its attacks, will be found at pp. 19, 20 in the preceding paper. The infestation to Clover has been so fully entered on in my 18th Report, under the head of "Clover Stem-sickness," with notes of prevention, that it is unnecessary to repeat the observations here; but the reader will please notice that the observations only refer to the special disease, "Stem-sickness" caused by the "Stem Eelworm," and recognisable by the deformed growths of the Clover plants. Disease caused by unfavourable weather, unsuitable soil, or fungus attack, commonly known as "mould," fall under different considerations.

American Clover-seed Midge. *Cecidomyia leguminicola*, Lintner.



CECIDOMYIA LEGUMINICOLA.

1, Clover-seed Midge; 2, maggot; 3, portion of female antenna, with minute hairs figured on lowest joint; 4, portion of male antenna; after Professor Riley; 5, anchor process; all magnified; after Dr. Lintner; 6, anchor process, figured from English specimens, also magnified, by Ed. Nat. length given in descriptions.

So far as we are aware, the American Clover-seed Midge has only appeared lately in this country, but still we cannot tell with certainty how long it may have been here.*

From the well-marked differences in form which I have found on examination of the anchor processes of "red maggots" found hybernating in the earth at Clover roots during the winter, I am aware that two kinds of Cecids are present, and very likely the maggots of both kinds may feed on the seed. Of these two kinds, however, I have only as yet been able to note the American Clover-seed Midge, the *Cecidomyia leguminicola*, Lintner, in its various conditions, that is, as present as a red maggot in the infested seed heads in summer, and in the ground in the winter, and also as the perfect Gnat Midge.

The species is of comparatively recent observation even in America. An insect much resembling it in appearance, and very likely of this species, was observed about 1850; but it was not until the year 1879, after careful watching for a year or two, that the Gnat Midge was reared by Dr. J. A. Lintner, now State Entomologist of New York

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* Careful observation is requisite in identifying this attack. Besides the possibility of another kind of *Cecidomyia* attack being present in the heads, there are also small brilliantly red-coloured fly maggots, very much resembling the *Cecidomyia* maggots in shape, but distinguishable by having a very few longish hairs, especially at the tail; also by the absence of an anchor process, and by the presence of two lobes or wide processes at the tip of the tail, each of which are sharply bifid. Besides these is the long and well-known attack of the maggots of the Clover Pear-shaped Weevils to Clover seed in the heads. These are much the same size, and do mischief much in the same way as the *Cecidomyia* maggots, but may be distinguished by being white, fleshy, and furnished with a brown head, armed with jaws. For figure see p. 27.

State, and determined by him as a new species. Observations of the life-history were published successively by Dr. Lintner and Professor Riley, and in 1881 an excellent and exhaustive paper on this same insect was published by Prof. W. Saunders, in the 12th Annual Report of the Entomological Society of Ontario. This paper embodies all information up to date on habits and life-history of the insect, together with serviceable suggestions as to prevention and remedy. In this country also we have come, so far as I am aware, very gradually to a certain knowledge of the *C. leguminicola* being here.

Notes were sent me which pointed to its possible presence here a few years ago, and later on, in the winter of 1888–89, I found specimens of maggots agreeing with descriptions of the Clover-seed Midge maggot amongst specimens which were hybernating at the roots of Clover, and about the third week in April I reared from these larvæ a specimen of the true Clover-seed Midge, the *C. leguminicola*, Lintner. It was not, however, until the middle of September, 1890, that I had an opportunity of seeing the maggots in their summer condition, destroying the seed in the heads of Red Clover exactly as described in the American reports.

On Sept. 16th, Mr. Alfred Hutley, of Derwards Hall, Bocking, Braintree, Essex, wrote me that he enclosed a few of the heads of Red Clover, which he had purposed saving for seed, but finding, on examining a section of the heads, that a maggot had destroyed a large proportion of the seed, he had cut it that day for hay, and wished to know if there was any remedy or prevention of the attack.

These maggots were almost indistinguishable, by the naked eye, from the well-known "red maggot" of Wheat. They were footless, of various sizes, from about the sixteenth to the twelfth of an inch in length, and of various shades of orange or somewhat pinkish orange. The "anchor process" (that is, a horny process beneath the body near the head, which varies much in form in different species of *Cecidomyia*) was deeply cleft or notched at the extremity, as figured at p. 28.

On tearing open some of the Clover heads I found that, besides the "red maggots," which had left them during transmission, there were still some remaining amongst the calyces of the florets, and also a great many of the husks were either without seed, or with the seed in injured condition. One head amongst the specimens sent, in which the seed was rightly developed, contrasted very strongly in regularity of form and size of husks containing the seed, and also in uniformity of colour, with those where, apparently solely from this infestation, the seed within had been ruined.

The maggots agreed in all noticeable respects with the American descriptions, and also in the habit of leaving the flower heads to go through their changes in the ground, or on the surface of it, below the infested plant. The regular method of life where noticed in America, is for the maggots of the first brood to leave the Clover heads in July. The gnat midges from these come out in August, and the maggots from eggs laid by these will be in the Clover heads of the late crop in September.

The maggots of the late brood may, according to weather and special circumstance, remain undeveloped to the perfect insect until the following spring, or the gnat fly may appear during the autumn or winter.

To the unassisted eye, this appears merely like a little blackish or brownish two-winged gnat, about the eighth of an inch in length, and so much resembles the Clover-leaf Midge which is a European kind, that the two species can only be distinguished trustworthily by microscopic examination.

Of this (the *Cecidomyia trifolii*, Loew.) Dr. Lintner says the principal differences given are its smaller size, and two antennal joints less in the female (fourteen instead of sixteen).

In order to be perfectly certain of the identity of the species which I reared, I submitted a specimen to Mr. R. H. Meade, of Bradford, who kindly examined it and informed me "that it is without doubt Lintner's *Cecidomyia leguminicola.*" The specimen was a female, and corresponded, in the important point of characteristics of the antennæ, with the figure and description.

The following is the description of the Clover-seed Midge given by Prof. Saunders:—"The perfect insect is a minute two-winged fly, about the size and general appearance of the common Wheat Midge. The head is black; the antennæ long, yellowish red, with sixteen or seventeen joints in the female, and fifteen in the male. Wings nearly transparent, clothed with many short curved blackish hairs, which give them a blackish appearance; each wing has three longitudinal veins, the third either forming a fork, or else becoming more or less obsolete towards the tip. Hairy fringe of wings paler and composed of longer hairs than those on surface of the wing. Abdomen fuscous with black hairs above on each segment; thorax black and clothed with rather long hairs. The male has an extended pair of clasping organs on the hinder extremity; the female a long pointed ovipositor, about twice the length of the abdomen." *

In the same paper Prof. Saunders notes "that the method of change is for the maggots after they have left the Clover heads and gone down into the ground, or into leaves or rubbish on the surface, to spin each for itself an oval compressed rather tough cocoon of fine silk, with particles of earth or other material adhering to the outside." "The duration of the pupa state of the early brood is about ten days."—(W. S.)

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* See paper on the Clover-seed Midge, *Cecidomyia leguminicola*, Lintner, by Prof. W. Saunders. 'Twelfth Annual Report of Ent. Soc. of Ontario,' p. 39.

Prevention and Remedies.—From the nature of the attack nothing at all can be done to stop the ravages of the maggots, when once they are established in the heads. The only paying course then is to cut the crop for hay.

Something, however, towards prevention of sowing a future infestation together with the seed may be done by careful examination of the seed before sowing. Most of the maggots leave the seed heads, but not all. In specimens sent me at my request from stacked infested Clover, I found maggots of this kind present on the 20th of October. As the maggots may live on amongst the seed until next spring, as they would have done in the ground, attention to this point is strongly urged amongst American methods of prevention.

Prof. W. Saunders, Director-General of the Government Experimental Farm Stations of Canada, says:—"It is of the utmost importance that farmers exercise the greatest caution in the purchase of Clover seed, else, while sowing their seed, they may at the same time be sowing an enemy, that will to a greater or less extent destroy the crop. Seedsmen also should exercise great care, otherwise they may be the means of seriously injuring the Clover-growers in the district by the introduction and dissemination of this pest." *

Infested seed may be easily known by looking for the "red maggots," which will show as little orange or reddish bodies amongst the grains. Seed may very likely be foul, if from infested Clover heads, whether it is home-grown or imported from America. Obviously such seed should not be purchased, and if it is sown with the maggots or chrysalids alive in it, this amounts practically to putting in the seed of the infestation along with the seed of the next crop. Various methods of disinfecting the seed have been suggested, as putting it in a closed vessel and exposing it to fumes of bisulphide of carbon, or some kind that would destroy the grubs. But in this method care must be taken *both as to what is used and the amount.*

Dressing or steeping the Clover seed in the way often practised with Wheat would in all probability kill the red maggots; but experiment here also would be needed, both as to what kind of applications might be used with safety, and also what strength is safe. If the seed was left too long after being wetted before being sown, this also might ruin the germinating powers.

In the case of dressing Beans infested by the Bean-seed Beetle, it has been found that Calvert's carbolic acid has been of service, and also a dressing of 1lb. of "blue vitriol," and 1 pint of McDougall's sewage carbolic, with 6 quarts of water. This was used with success for 6 bushels of Beans.

How far the above would be safe for the small Clover seeds even when far more diluted than in the above proportions, I do not know, but it might be expected that an exceedingly weak solution would kill the maggots, and it would be well worth while to experiment as to what would be, at the same time, a safe strength for the seed.

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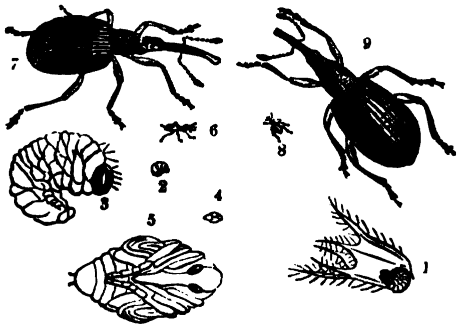
* See Report by Prof. Saunders previously quoted.

Where a district is infested, the only plan known of getting the infestation under is either to leave off Clover-growing for a while, or to cut the crop whilst the flowering heads are still in an early condition. Thus it may be taken whilst the maggots in the heads are still so young that they will die for want of the supply of food that the growing seed would have furnished before they reach maturity, and condition for full development.

Where infested Clover ley can be broken up towards spring, when the maggots are turning to the chrysalis state, this would destroy many of them. Early in the winter, or in the autumn, it would kill some that were buried down too deeply for the gnat midges to come up through the ground after development, but would probably only temporarily disturb many of them which were still quite able to rebury themselves.

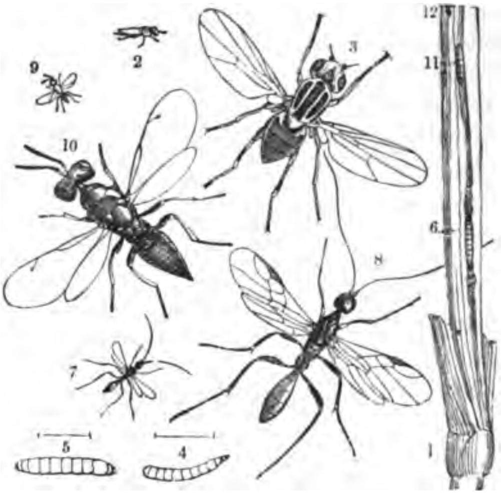
As it is very possible that the above infestation in Clover heads may be confused with that of the Clover Pear-shaped Weevils (Apions), of which the little whitish maggots are also very injurious to the forming seed, I add the figure of this weevil beetle in its different stages. It will thus be seen that the two kinds of minute seed-feeding maggots, although about the same size, may be easily distinguished by the beetle maggot having a distinct dark head, as well as by being commonly of a much paler tint than the various shades of orange-pink or red of the midge maggots.



6, 7, *Apion apricans*; 2—5, maggot and pupa; 8, 9, *A. assimile*; all nat. size and magnified; 1, maggot feeding, magnified.

CORN AND GRASS.

Gout Fly; Ribbon-footed Corn Fly. *Chlorops tæniopus*, Meigen.



CHLOROPS TÆNIOPUS.

2—6, 11, maggot, chrysalis, and fly, nat. size and magnified; 7 and 8, *Cœlinius niger*; 9 and 10, *Pteromalus micans* (parasite flies), nat. size and magnified; 1 and 12, furrowed Corn stem.

The attack of the *Chlorops*, or Gout Fly, is one of the very commonest and most regularly recurring of those insects injurious to the growing Barley ear and stem that we have in this country; and all moderately observant agriculturists cannot fail to know the presence of the infestation well, by the swelled and deformed growth of the sheathing-leaves of the ear, which sometimes, as in the opposite figure, is unable to escape from them, and remains as a stunted plant for life.

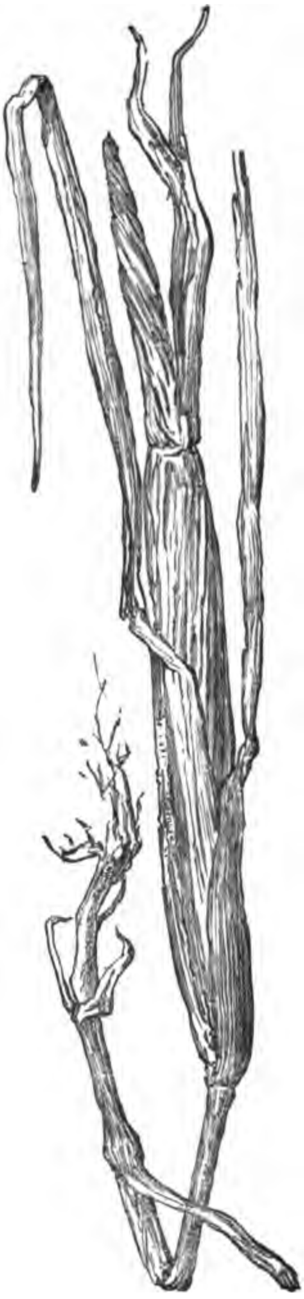
More frequently, however, it wholly or partially escapes, and then the attack is recognisable by more or less of the lower part of the ear having been destroyed by the fly maggot, and a brown or blackish channel being observable from the ear down one side of the stem to the uppermost knot (see figure). Here the legless whitish maggot has fed its way onwards, and there it turns, within the sheathing-leaves, to a rusty-brown chrysalis, from which the little stumpy-made, two-winged, black-and-yellow flies come out very soon, and may be found sometimes, as I have found them myself, in such numbers in an infested stack just harvested, that when I have thrust one arm well down amongst the straw I could sweep the flies out in such numbers that they fell fairly rattling down on the sheet of paper I held below.

All this, that is, the *summer* history and habits, is perfectly well known; but (so far as I am aware) it was not until this past season that an observation of *winter* attack was secured in this country. In this case the kind of injury is necessarily different in form from what takes place in summer. The following description is taken from the very clear account quoted by Dr. E. L. Taschenberg from the paper by Prof. Max Nowicki *:—

An egg is laid on the leaf of the winter Corn, or of a wild Grass. The larva, which hatches very soon, bores into the inside of the young plant, even to the neck of the root, and there it passes the winter; but it is not till growth begins again, towards spring time, that the infested plants are distinguishable from the others. Then the infested shoots assume a somewhat bulb-like appearance, with broader leafage, and the whole growth thicker than the growth of the uninfested shoots.

In these shoots the *Chlorops* maggot is to be found, and in due course, whilst the over-luxuriant infested shoot perishes, the insect goes through its changes within, and emerges as the perfect fly, in time to start infestation in the summer Corn. (This may be Barley, Wheat, Rye, or wild Grasses.—Ed.)

This form of attack has been watched for (or rather I have suggested it would be very desirable to watch for it) for several years back, and in the course of May last year specimens of infested young Wheat plants were placed in my hands for examination by Mr. C. Whitehead (Chairman of the Seeds and Plants



Plant of Barley entirely stunted by Gout Fly attack.

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* Nowicki, Prof. D. Max, uber die Weizenverwüsterin *Chlorops tæniopus*, Mg., und die Mittel zu ihrer Bekampfung. Wien, 1871.

Diseases Committee of the Royal Agricultural Society), which he had received from Dr. Fream, of the College of Agriculture, Downton.

The specimens from which these were taken, Mr. Whitehead informed me, were sent to him about the middle of April, and from them one of the perfect "Gout Flies" emerged on May 11th. This first specimen Mr. Whitehead placed in my hands, and as there were points about it which made me hesitate as to whether it could with absolute certainty be considered the common kind of Gout Fly known as *Chlorops tæniopus*, and also it was found in Wheat (which with us is less commonly infested than Barley), I submitted the specimen to Mr. Meade, of Bradford, who was good enough to examine it, and replied as follows:—"I believe your *Chlorops* to be a female of *tæniopus*; it is *not lineata*. I thought at first that it might be *C. nasuta*, which is a very variable species, but upon close examination I feel convinced that it is a variety of *C. tæniopus*."

Of the other specimens sent me, one chrysalis case had fallen from the plant, so that I could examine it, and I did not observe any difference between this and the common form of Gout Fly chrysalids, and within it the fly was so far advanced that its shape was clearly distinguishable. Another chrysalis was low down in the centre of the little plant, of which I noticed that one at least of the leaves was much wider than in natural circumstances.

This observation is of interest as showing that the winter form of attack is to a certain extent present here; but until we know more about its prevalence, and especially whether it may commonly be found in Wheat, we can hardly utilise it practically.

It may be useful, however, to give a short description by which the maggots of three different kinds of flies, all of which do mischief very much in the same way in their method of winter attack within the shoots of young winter Corn (that is, independently of their summer method of attack), may be distinguished from one another.

These are the maggots or *larvæ* of the Gout Fly or Ribbon-footed Corn Fly (*Chlorops tæniopus*), the Frit Fly (*Oscinis frit*), and the Wheat-bulb Fly (*Hylemyia coarctata*).

These maggots all resemble each other in being whitish or yellowish in colour, legless, cylindrical in general shape, but somewhat tapering towards the head end which contains the mouth hooks, and blunt at the tail extremity.

The maggots of the Gout and Wheat-bulb Fly may be generally described as about the fifth of an inch in length when full-grown; those of the Frit Fly are smaller.

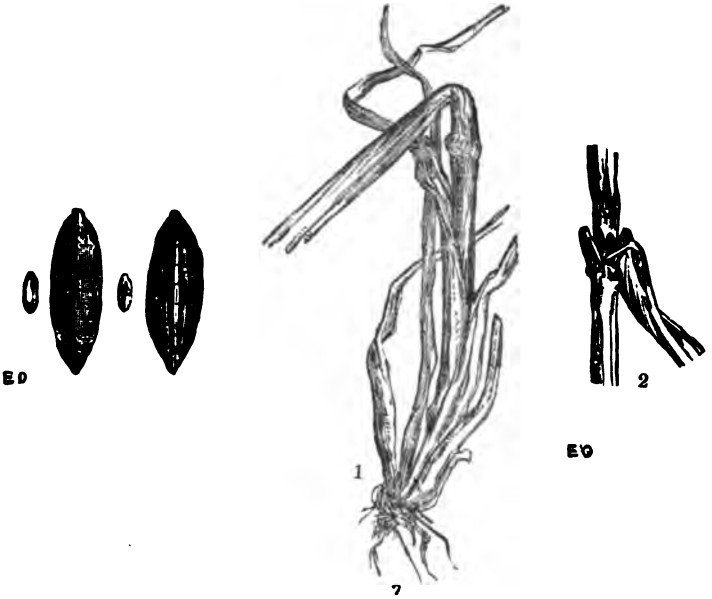
The main differences between these kinds of maggots, as seen with a tolerably strong magnifier, are as follows:—

The maggot of the "Gout Fly" has two spiracles, projecting like two white points, at the blunt or rounded hinder extremity, and the pair of mouth hooks at the somewhat tapering front extremity (what may be called the head end) are very small. The maggot of the "Frit Fly" has two projecting spiracles at the blunt hinder extremity, and is bluntly pointed at the head end, which contains two strong mouth hooks, and on each side near the head it has a branched spiracle. The maggot of the Wheat-bulb Fly has a pair of fleshy, somewhat flattened, square teeth at the extremity of the blunt hinder extremity, and on each side of this central pair is one tubercle or tooth and sometimes more. When examined under a magnifier the central teeth will be found to be concave at the extremity. The head end contains two powerful black mouth hooks. For figures of these details see paper on Wheat-bulb Fly.

On the 9th of July, in the past season, Mr. Eardley Mason wrote me from Alford, Lincolnshire, that on examination of fields in that neighbourhood he found *Chlorops* attack was abundant, but otherwise only a few observations of presence of the infestation were sent me. These, for the most part, were only enquiries as to the nature of the attack, with specimens accompanying; the dates of application being from July 29th to August 25th; the localities near Bridgwater, Leominster, Doncaster, and Nottingham. Amongst these, however, the following note is of interest, which was sent on the 29th of July, from Springhill, Bulwell, Nottingham, by Mr. Arthur Gibson. This, it will be seen, gives an estimate of loss, and also notes that the infestation only occurred where seed from a locality and kind of land named was used. Mr. Gibson wrote:—"I have taken them (the specimens of infested Barley, Ed.) from a 16-acre field of Barley. I notice the attack on one side of the field only; the crop generally is a heavy one, but at the spot from where I gathered these ears there would, I should say, be quite 10 per cent. similar to those I send you. I had the seed from Goole,—Wharfe land. My other fields appear quite clear from the pest where different seed was used."

No advance was mentioned in methods of prevention or remedy beyond what has been previously reported, and of these the most practicable measure appears to be that brought forward in 1889 by Prof. W. McCracken, as observed by himself at the Royal Agricultural College, Cirencester, of the beneficial effects of early sowing. In the instances he gave me (see my 13th Report) the portion of the crop sown in March was free from injury; that sown on April 6th was injured to the extent of 2 per cent., and that sown on May 3rd to the extent of not less than 20 per cent.

Hessian Fly. *Cecidomyia destructor*, Say.



1, Barley stem elbowed down by Hessian Fly attack; 2, showing position of "flax-seeds." Also "flax-seeds" or puparia nat. size and magnified, showing the early and smooth, and the later or striated, condition.

From the reports of the past season (joined to those of the previous years), since Hessian Fly was first recorded in 1886 to be present as a crop pest in this country, the infestation appears to be distributed at localities in most of the English counties excepting the most westerly and south-westerly, but at the same time so far as the reports sent to myself show, the injury caused is for the most part what is described by various of the English observers as "immaterial," "slight," or of "no consequence," a "trace" and so on.

The highest estimate of damage sent, and this only from one locality was in Barley, two stalks in well grown crop, and ten in shortish crop in square yard; in Wheat from two to five stalks.

From Scotland, whilst notes were sent of non-observation of the attack at various localities, I had only at the most two of its presence, and one of these mentioned the mischief locally as "very considerable," the only note sent of serious injury.

As this attack still continues to be of considerable interest, I give the following notes in the order of date, and in the words of the senders (so as to convey the precise information sent), and append remarks on some points on which information up to date is desirable, more especially regarding parasites and altered forms of growth by which the winter attack of Hessian Fly maggot in young Corn may be recognised if present.

My first note of Hessian Fly presence in the past season was a short remark from Prof. Harker, of the Royal Agricultural College, Cirencester, on the 19th of July, "Hessian Fly very numerous."

On the 25th of July, Mr. Geo. E. Palmer, of Revells Hall, near Hertford, who it will be remembered was the first observer of this pest in England, wrote me in reply to my request for information as to amount of attack:—

"I have made a careful examination of our Wheat and Barley crops with the following result.

"*Barley.*—Damage from the Hessian Fly slight, a few stalks here and there being broken down and containing the puparia.

"*Wheat.*—No perceptible damage, although there is occasionally a stalk attacked or broken down. On the whole I should say Wheat and Barley in this neighbourhood are very little damaged by Hessian Fly. It is possible that there is more of the pest in the Barley than can be seen by observation now, as the heavy rains have laid the Corn badly, and it will not be till the straw is passed through the thrashing-machine that we shall be able to see what amount of the puparia there is in it.

"In my opinion it will only be in dry seasons that we shall experience much damage to our crops from this fly."

Mr. Palmer's view, as above stated, of but little damage being done by the Hessian Fly, was later on confirmed by the results of thrashing two stacks of Barley, of which he sent me a special note, on Oct. 24th, in reply to my enquiries:—

"Judging from the amount of puparia to be found in the screenings, I should say that there was not so much Hessian Fly this year as there has been previously, and this receives further confirmation from the fact that the yield of Barley is the largest we have had for a good many years. I have not been able to ascertain what amount of damage has been done on neighbouring farms, but I do not think in any case it has been at all serious, or I should no doubt have heard of it."

Returning now to the reports of amount of presence on the growing crop:—On the 25th of July, Mr. S. L. Mosley, writing from Beaumont Park Museum, Huddersfield, observed that he had looked for the Hessian Fly repeatedly in that part of Yorkshire, but had not succeeded in finding it.

At the same date, also, Mr. J. Eardley Mason, writing from Alford, on the east of Lincolnshire, observed, "I reply to your enquiry respecting Hessian Fly that I have found it, both as larvæ and puparia, in every field I have examined, but sparingly."

On the 30th of July, Mr. D. Taylor, of Daleally Farm, Errol, N.B., who has reported on the pest at intervals since his first observation of it in Scotland in 1886, wrote, in reply to my enquiries, that some spots were pretty sorely attacked; "but generally speaking, for I went out and made a thorough inspection of Wheat and Barley last night, the number of attacked stalks in a square yard I find to vary from two in thick well-grown Barley to, say, ten in a shortish thin crop. The Wheat being stronger is not so broken down, say from two to five in a square yard. But one fact here, and I would like if others would report their experience: I find that in the thin weakly crops growing under cover of trees, or say in a sheltered situation, as much as (well, putting it inside the mark) forty per cent. are broken down; in fact, this seems to me to be the very hot-bed as it were, or happy hunting-ground of this Cecid. It is, however, only part of an end rigg or headland, but it shows where amongst all the others the situations in which they most delight are."

On the 29th of July, Mr. Francis Percival, of Thornhaugh, Wansford, Northamptonshire, forwarded samples of Hessian Fly infestation in Barley, mentioning that he found it was eating the straw in two and doing much damage.

The straw I found to be *very* poor, with one *puparium* or "flax-seed" on each stem, and the straw bruised or broken away close to the point of infestation.

During the past season several instances have been sent of straw which was (or had been) infested, being much injured above the point where the maggots had fed, the stem being broken or torn into ribbons, or bruised in a way which did not seem at all attributable to effect of Hessian Fly attack, even if several maggots had been present, much less where there was only one. The only explanation that suggests itself appears to be that of small birds, or possibly insect-feeding mice, tearing at the spot to get at the "flax-seeds." But at present I am without any evidence as to the cause of the injury, and it would be very desirable to make this point out, for the state of things does a good deal of harm.

At the same date, that is, the 29th of July, Mr. Edm. Riley, writing from Hessle, near Hull, reported the Hessian Fly infestation as not present in that neighbourhood, and as not amounting in any case to as much as one per cent. near Goole, where he had examined the infested crops.

Mr. Riley wrote:—"I have not yet seen any here, but at Goole, where we found it three years ago, you could find it in several fields a fortnight ago. The damage is so immaterial that I thought it not worth while mentioning it. The Wheat in that district (warp-land) grows so strong that you find it when the stem is *not* broken down.

I should say that in no case is one per cent. damage done, as the Wheat ripens as well where the insect is on such land, where the attack comes late."

On the 4th of August, Mr. Riley further reported, "I have not found the Hessian Fly here, only at Goole this year."

The following letter, sent on July 30th, by Mr. Geo. Malden, of Cardington, Beds., is of interest, as giving some amount of estimate of damage since the first observation of Hessian Fly attack in that neighbourhood in 1887. Mr. Malden observed:—"So far this season I have only just walked in a Barley crop for about five minutes when I saw four or five straws that were attacked. This is the fourth season I have noticed it among our crops. In 1887, both Wheat and Barley were somewhat seriously attacked, and upon counting I estimated the damage between 1½ and 2 per cent. I believe that was the first noticed in this district. Both in 1888 and 1889 it was to be found in all fields, though considerably less than in 1887; probably ·5 per cent of the straw were attacked."

A few days later (on August 2nd), Mr. Malden wrote further, mentioning the very small infestation to which the Hessian Fly presence amounted, even where he noticed it in all the fields examined. Mr. Malden wrote:—"I have suspected our crops and some of our neighbours', and, though the Hessian Fly is to be found in all Wheat and Barley fields, there is not nearly so much as the last two years, and can only be called a trace."

On the 31st July, Mr. W. McCracken, late Professor of Agriculture at the Royal Agricultural College, Cirencester, sent the following note from Crewe, Cheshire; and here, as in most of the above observations, it will be seen that the damage was not considered to be serious:—

"I am sorry to have to report that the Hessian Fly is once more at work in this neighbourhood. Yesterday and the day before I found specimens of the 'flax-seeds' in the only two fields I examined. These were about 17 miles apart, one at Sandbach in Wheat, and one at Spurston in Barley. The latter field is the same in which I found specimens last year amongst Wheat. In neither case had any damage of consequence been done."

On the 5th of August, Mr. McCracken further added:—"Since writing to you I found the Hessian Fly at work in a field of Wheat not far from Market Drayton, in Staffordshire, just over the Shropshire boundary."

On the 1st August, Mr. T. Freke Lewis, of Abbey Dore, Hereford, forwarded specimens of straw much bruised, broken, and brown. Where the Hessian Fly chrysalids were noticeable they appeared quite small or crushed. In one case the "flax-seed" lay as usual a little above a joint, and a little above it the stem was cleanly bitten about half through. This was one of the cases of injury noticed at p. 34, of which the cause is not at present clear.

On the 8th August, Mr. D. D. Gibb, writing from Ossemsley Farm, Lymington, Hants, mentioned that he found, on examination of Wheat and Barley on Major W. Murray's property at Ossemsley (Christchurch) and Wootton (of which he had the management), that he had proof of presence of the Hessian Fly in both places; and he further noted:—"From the boisterous and wet weather the crops present a tangled and twisted appearance, and it is therefore difficult to pick out infested plants, as these in many cases do not present such a blighted appearance where they are attacked by Hessian Fly as from other causes."

The following note, with which I was favoured, on the 5th August, by Sir J. T. Stewart Richardson, Bart., of Pitfour Castle, Perth, is of especial interest, regarding effects of soil on amount of presence of the Hessian Fly:—"The damage by Hessian Fly both to Barley and Wheat in this district this year is very considerable. The puparia in the Wheat straws seem to have fallen out to a large extent, but those in the Barley seem all yet firmly lodged in the straw. The attack is only on the crops in the black land, and not on the clay; so much so that in one Wheat field the damage is great at one end, and the clay end is free. . . . . . We have had no attack since I wrote to you in 1887."

On the 8th August, Mr. Eardley Mason, writing from near Alford, Lincolnshire, mentioned:—"The Hessian Fly is doing more harm than I at first thought probable, comparing this year's attack with those of previous seasons. The harm is less in respect of the actual loss of grain than in the entangled state of the crop, where there is any considerable amount of fly, rendering the harvesting anything but clean. Cut-off ears strew the ground, and are seldom gathered up."

The latest note of observation of the presence of Hessian Fly in the standing crop was sent me, on August 20th, by Mr. Arthur Smith, from Smallford, St. Albans:—"I am writing just to inform you that the Hessian Fly is in existence in the Wheat here, but have not yet discovered any in Barley. The damage done is small."

Where direct estimate of amount of injury is given in the above observations it will be seen that the highest sent (on the 30th of July) only amounted to "Barley: number of attacked stalks in a square yard about two in well-grown crop, ten in shortish thin crop. Wheat, say from two to five in square yard." The other returns, excepting that from the neighbourhood of Perth, in which the damage is noted as very considerable (but even in this case is mentioned as only occurring on kind of land specified), stand as follows:—

"Barley: damage slight, a few stalks here and there broken down.

Wheat: no perceptible damage." "No damage noticeable." "Larvæ and puparia in every field, but sparingly." "In several fields, damage immaterial; in no case one per cent. of damage done." In two localities about 17 miles apart, "in neither case had any damage of consequence been done."

In the observations of the past as well as of those of previous seasons, the vigorous and healthy state of the crop is noticed as an important help in lessening amount of attack, or consequent injury, and a few observations are given as to results on various kinds of soil, or where nature of locality, as shade, affects the health of the crop.

Full details of the method of Hessian Fly attack, and also measures found useful both for lessening amount of infestation, and for lessening its injurious effects on the attacked Corn, have been given so repeatedly since the autumn of 1886, that they are thoroughly before the public.

Destruction of infested screenings.—Some remarks, however, may still be usefully made in confirmation of the most important preventive measure of all, namely, destroying the "flax-seeds" (that is, the chrysalids or *puparia* of the Hessian Fly), when they are thrown down by thrashing-machines amongst the light screenings from infested Barley or Wheat straw.

In these circumstances, what (according to our own treatment) will or will not be the origin of future attack, lies in our own hands. If the light screenings with their contents are destroyed (which may be done with no loss of material, and scarcely any labour) there is a clear end of the matter. If, on the contrary, the screenings are preserved, the insect contents, whether Hessian Flies or their parasites, will go forth, and we allow another year's mischief to take place.

The parasite attack does not prevent the infested pest living on the straw up to the change to the chrysalid or flax-seed state,* so that it appears to make little difference practically whether the Hessian Fly maggot damages the straw simply for its own feeding, or to support in addition the parasite maggot within it. In either case we submit to another year's attack which might have been spared.

Another form of the same plan of preservation which has been theoretically advocated is breeding the various contents of the flax-seeds, and selecting the parasites to turn loose. But this would involve great risk. None but well skilled entomologists can tell with certainty amongst these excessively minute creatures whether it is pest or parasite they may propose to turn loose in our crops, and the most serious consequences might be expected to ensue.

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* This point is clearly shown by the observations of Dr. C. Lindeman, the great Russian authority on the habits of the Hessian Fly, who has himself bred the following parasitic flies from Hessian Fly puparia, namely,—*Merisus intermedius; Tetrasticus rileyi; Semiotellus nigripes; Eupelmus karschii; Platygaster minutus,* and *Euryscapus saltator;* all these species have been identified by Prof. C. V. Riley as present parasitically in this country.

Hessian Fly, nat. size and magnified.

On this point we have the advantage of a very clearly expressed opinion from the excellent authority of the Entomologist of the Dept. of Agriculture, U.S.A. Prof. Riley states :—"At present, and with general entomological knowledge in its present state, there can be no doubt that it will be advisable to burn or otherwise destroy screenings which examination shows to contain puparia. It is a great bother for any one to breed parasites, and for a practical man it is out of the question." *

No observations were sent me of presence of the attack in the autumn-sown or winter Wheat.

Winter attack.—As yet I have received no information of winter attack of Hessian Fly being present, that is to say the form of attack caused by the Hessian Fly laying her eggs on the young autumn Corn shortly after it has come up, which attack is necessarily quite distinct in form to the summer infestation.

Presence or absence of this is of enormous importance, as so long as we do not suffer from this not only is the growing crop safe, but we are spared the increased amount of multiplication which would otherwise have taken place. It may therefore be of practical interest to give some special observations as to the appearance of the infested crop.

The fly is stated to lay her eggs at the sheathing base of the leaves of the young plant, just above the roots or near the surface.

The appearance of the attacked plant is described by Prof. F. M. Webster, of Lafayette, Ind., U.S.A., in his circular on Hessian Fly, with figure (now given opposite) showing the fly maggot at "*a*."

"The plant itself has not tillered, the leaves are of a *darker* colour than those of a healthy plant, and proportionally broader. The central spindle-shaped leaf is missing, and the whole plant is only a bunch of rank-growing leaves. In any case the darker colour of the leaf and the absence of the central leaf, together with the bunchy appearance of the part affected, will readily distinguish a fly-infested plant from one not injured. The yellow colour of some leaves is seldom observed at this season of the year on fly-infested plants."

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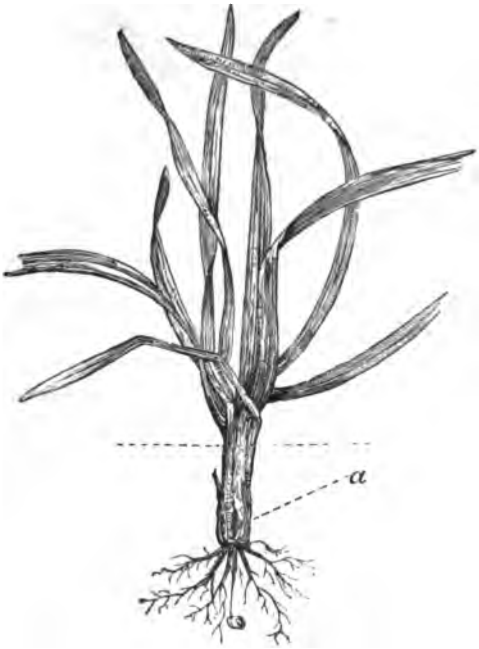
* 'Insect Life': periodical Bulletin of U.S.A. Dept. of Agriculture, March, 1889, p. 294.



Dr. Lindeman states:—"At first scarcely any stoppage in the rate of growth is to be observed, as is the case in a long continuation of drought, but soon the young plants begin to wither and at last die away; also the plant leaves commonly all wither at the same time, with but very little change of their green colour. If we examine the dead plants closely, we find that neither leaves nor stem are gnawed, that the root is healthy, regularly developed, and branching, and that there are no traces of the characteristics of insect-feeding known as worm meal.

"The plant appears killed as if by being simply dried up. Low down by the root it is commonly swollen, and here, in the axil of the leaf, is either the maggot of the Hessian Fly, or still more frequently the puparium itself, in appearance a brown elliptical shining body extraordinarily like a flax-seed.*

The above descriptions may serve as guides as to existence of winter infestation, or conditions where it has been.

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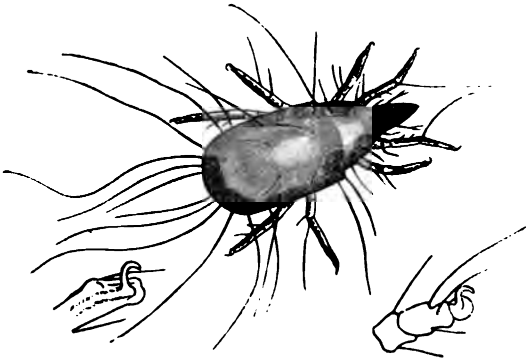
* Die Hessenfliege (*Cecidomyia destructor*), Say, in Russland, von Dr. K. Lindman, Moscow, 1887. (Eng. Trans. M.S., by Georgiana E. Ormerod, pp. 22, 23.)

Mites (in Hay). *Tyroglyphus longior*, Gervais.



TYROGLYPHUS LONGIOR.

T. longior (from fig. by Fumoze and Robin): claw and sucker of *Tyroglyphus*, right-hand side (from Murray's 'Aptera'); claw and sucker on left-hand side, figured by ED. from life. All magnified.*

In the course of November (in 1886) specimens, or rather small masses of Mites (or *Acari*), were forwarded to me by the Editor of the 'Farmers' Gazette,' Dublin, on the part of Mr. T. Robinson, Land Steward to Sir John Gough, Knockcreven, Clonmel, with the information that they were dropping in great numbers from the sides of a hayrick, and the precise name and nature of the infestation was wished for.

The Mites did not appear to me to differ from the kind of "Cheese Mite" scientifically known as the *Tyroglyphus longior*; but, as I had not especially studied the *Acari*, and the presence of Cheese Mites in a haystack was then an entirely new observation to me, I distrusted my own views, and suggested that application should be made to Mr. Albert Michael, F.L.S., as a most trustworthy authority.

Mr. Michael found on examination that the Mites were, as supposed, the species of Cheese Mites known as the *T. longior*, and further added much valuable information, which, by the courtesy of the Editor of the 'Farmers' Gazette' in having the communication copied for me, I give on the following pages. I did not insert the observations in my Report for 1886, as I was not then aware of it being other than a quite exceptional occurrence.

Since then, however, notes of another apparently similar attack were sent me, and at the beginning of October of the present year (1890) I had again notes sent of the presence of what appeared to me to be precisely the same kind of Mite dropping in vast numbers from hay stored in a loft. Under these circumstances the attack proves of sufficient practical interest to notice.

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* The real size can hardly be conveyed so as to give any clear idea. It is rather more than half the 25th of an inch in length.

The general appearance of these Mites may easily be seen by any one who will examine a little of the living dust-like matter often to be found in old cheese, by placing it under a microscope or fairly strong magnifying glass. The order of *Acarina*, or Mites, are mostly very minute, and are distinguishable from insects in any stage by their very minute size, and by having head, body, and abdomen all in one piece; they are for the most part furnished with four pairs of legs when they are full-grown, three pairs when they are just hatched.

The subfamily of the Cheese Mites (*Tyroglyphidæ*) is more especially distinguishable by the fleshy soft whitish body, somewhat elongated in form, with conical proboscis; the jaws shaped like crabs' claws (chelate); and the legs five-jointed, terminating in suckers or lobes for fixing themselves with. Amongst these *Tyroglyphidæ* the sub-genus *Tyroglyphus* is distinguishable by having *one* claw, as well as the sucker at the end of the leg; and amongst these *Tyroglyphi*, the *T. longior* (the kind we have found in hay, although its special attachment is to various kinds of cheese) is distinguishable from the *T. siro*, the "Common Cheese Mite," by being larger, longer in proportion, furnished with much longer and more shining hairs, and also by being much more rapid in its movements.* The rapid movements and the great length of the hairs are very easily observable microscopically.

The figure at the head of this paper shows the numerous and long hairs, the crabs' claw-like jaws, and the single claw, with the fine sucker ("like a sleeve") surrounding it at the end of the tarsus or foot. The claw drawn (magnified) on the right-hand side is from the figure given in Murray's 'Aptera,' p. 256, of a tarsus of the genus *Tyroglyphus*; that on the left hand is from a sketch taken by myself of the tarsus, or rather the extremity of the tarsus, somewhat more magnified, of the specimens sent me this year (1890). It will be seen that the shape of this claw and the outline of the sucker precisely correspond with the other figure; but I noticed the apparatus running up the foot for moving the claw more distinctly than appears in Mr. Murray's figure, and I did not observe the cross-line apparently intended to show a joint. The other characteristics noted were very plainly observable in the specimens sent me.

The first specimens, namely, those authoritatively identified in 1886 by Mr. Albert Michael, together with the observations of the nature of the attack sent by Mr. T. Robinson, and also some general considerations on the habits and means of prevention of the pest, are given at length in the following reprint of the correspondence from the 'Farmers' Gazette' (Dublin), Dec. 25th, 1886, for which I am indebted to the courtesy of the Editor, Mr. W. Hooper.

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* For notes from which the above short descriptions of characteristics are condensed, see Claus and Sedgwick's 'Elementary Text-book of Zoology,' and 'Aptera,' by Andrew Murray.

As I mentioned above, the letters and specimens were first submitted to myself for examination; but the infestation of Cheese Mites being then unknown to me as occurring in such a very abnormal situation, I did not like to rest on my own views until they had been confirmed by the sound authority of Mr. Michael:—

"MITES IN A HAYRICK.—Recently a small wooden box, about half the size of a small egg-cup, was sent us completely full of Mites, with the following note, intended for our query column:—

"'I have a rick of hay, from the sides of which there are numbers of the enclosed dropping out. What is the cause? Is it safe to feed stock with the hay?'

"Both to the naked eye and under a powerful microscope these minute creatures bore a very great resemblance to ordinary Cheese Mites, and on placing a piece of cheese near them it was soon discovered that they were eating it. We had heard of forage Mites being found in old hay, but had no personal experience of them, and thought it very improbable that the same *Acarus* would live on hay and cheese. We, therefore, wrote to the querist, Mr. T. Robinson, land steward to Sir John Gough, Knockcreven, Clonmel, for further particulars, and received the following reply:—

"'In reply to your letter of yesterday regarding Mites in hayrick, I beg to state that there cannot have been a mistake about the specimens forwarded to you, as I took them up and put them in the box with my own hands. There is no decaying substance in the rick, other than the hay, a sample of which I forward to you this day by parcels post. It is second-crop hay, which was cut about the 20th August, and saved without rain; but it remained some time in cocks in the field. The outsides got a little damaged from heavy rains. I think the whole rick is infested with them. They seem to be more numerous near the ground than at the roof, but that might be caused by the working downwards in the hay. The rick was made about seven weeks when I first observed them by the sides of it. The rick heated a little for about ten days after it was made, but only slightly, as the hay is now coming out good.'

"The sample of hay sent was in good condition (except that it was infested with Mites), and had evidently been well saved; it was, in fact, a superior sample of hay. Having procured another small box full of the mites from Mr. Robinson, we forwarded it to Mr. Albert D. Michael, of London, who has made Acarinology his special study, from whom we have received the following reply:—

"'Editor, 'Farmer's Gazette':—I have examined the *Acari* accompanying your letter of 6th inst. There are more than one species of Mite among those sent, but far the greater bulk appears to be "*Tyroglyphus longior*" (Robin and Fumoze); the others are in such small numbers that they may be neglected. *T. longior* is, as you evidently suspect, one of the Cheese Mites. The ordinary well-known Cheese Mite is *Tyroglyphus siro*, a species so like *T. longior* that it is difficult to distinguish the two. *T. longior* also lives in cheese, often in company with *T. siro*, and is frequently the more abundant of the two; they do not, however, either of them, confine their attention to cheese. *T. siro* thrives and multiplies equally well on flour, linseed meal, &c., provided other conditions be favourable; and, indeed, both species, and many of their allies, will attack an immense variety of dead and dried animal and vegetable substances; but they do not, as far as my experience goes, attack either in living condition, except that they appear sometimes to eat small fungoid growths; neither do they, as a rule, like substances in a state of decomposition. *T. longior* will thrive only too well on dried cantharides, and causes great damage in parcels of that material.

"'It is the characteristic of these two species, and some of their allies, that occasionally, when they find conditions thoroughly favourable, they increase to such an enormous extent that the substance they are feeding on seems to be wholly composed of the Mites; and a wholesale druggist lately offered to send me as many pounds' weight of the Mites as I chose to have. I should think that they were probably accidentally introduced into the hayrick (they are generally distributed), and that happening to find conditions of moderate warmth, slight damp, and appropriate food, which just suited them, they have increased to an extreme, but not altogether exceptional, extent.

"'I do not see any reason why cattle should be injured by eating them. We, ourselves, are not injured by eating them, which we do in great numbers in cheese. Moreover, the fodder in warm stables and cow-sheds is generally pretty abundantly supplied with this and other allied species, but the horses and cows do not suffer from the circumstance, as far as we know. The only way in which it strikes me that they might be injurious is this,—that where minute creatures, like this, are in such immense abundance, as in the present instance, very large numbers are apt to get upon anything, whether living or dead, that is long amongst them; and although they are not in any way parasitic, yet the mere friction of such multitudes of minute claws, and of the fine hairs with which the creatures are so well supplied, often mechanically produces considerable irritation of the skin for a time; thus, porters engaged in unloading grain, and other things very much infested with allied creatures, have sometimes been affected with severe itching for a time, and have even refused to continue their work, on the ground that the grain was (as they thought) poisonous. This is a trifling matter with human beings; but with animals, which cannot clear themselves quite so readily, it strikes one as just possible that it might induce them to rub themselves, &c., until they set up more serious evils, and might keep them in a state of unrest. I have not, however, any knowledge of such a thing having actually occurred.

"'Finally, Mr. Robinson would, doubtless, like to know how to get rid of the creatures, and I fear I cannot help him much. I do not see how they can be eradicated from the rick, if it be deeply infected. If it could be pulled to pieces, and the hay in a loose condition exposed to dry heat, they would be killed, although even then it is possible that some eggs might survive; but this process would probably not be worth doing. At any rate, as the creatures in such abundance unquestionably do a good deal of damage, I would suggest that it would be well to try and limit the damage for the future, by burning all refuse of the rick and all sweepings round it, and infected matter on the spot, and not carrying them about, or throwing them upon rubbish heaps.'"—(Albert D. Michael.)

Another very similar observation was sent me subsequently from another quarter, of which I am not now able to give the full details; but in the course of the past autumn I received the following enquiry, accompanied by myriads of the Mites, and also some of the Grass tops, through the hands of the Editor of the 'Farming World,' Edinburgh:—

"Sir,—We have this day forwarded by post, box containing sample of 'Mites,' or insects like Mites, which are dropping in large quantities out of a lot of Rye-grass hay, bought by us some time ago. Hay this season's growth, first cut, got in good order, local grown. We have stored it in a large, airy loft, but at doors and windows these vermin are dropping in shovelfuls. May we venture to ask your opinion as to the effect this may have on the hay, if it may be given to horses without fear of any evil results following its use? So far the horses are eating it quite freely.—J. A. H."*

On most careful examination of these Mites with various microscopic powers, I found them to agree in every respect which I could distinguish with the "longer" and long-haired kind of Cheese Mite, the *Tyroglyphus longior*, previously identified, and figured at the heading. But still we do not know (so far as I am aware) either what is the reason of the occasional appearance of these Mites in the hay-ricks, or in hay in a "large *airy* loft," nor yet how we are to get rid of them.

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* See 'Farming World' Edinburgh, number for October 3rd, 1890, p. 631.

It is noticeable in the above account that the creatures did not appear at home in their quarters, for it is observed that "at doors and windows these vermin were dropping in shovelfuls." Also in the observation given by Mr. Robinson, at p. 42, he remarks that numbers of the Mites were dropping from the sides of the hayrick. These points suggest whether the Mites would have migrated and left the hay clean?

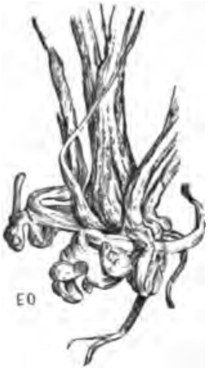
They dislike airy, dry situations, so that the airy loft would, on the face of the thing, be the kind of place from which they would be likely to remove. But we need further observations as to method of life; and especially, where found in lofts, whether there were any dairy buildings or other places near, from which they could have migrated.

As they multiply by hatching from eggs, a thorough purification of the floors, walls, and roofs of an infested loft would be highly desirable, as soon as it was emptied, in order to destroy all eggs and hatching, or young Mites. Probably nothing would answer this purpose better than a good whitewashing of everything accessible, for the bright white colour, would at once show whether the work was thoroughly done or not. It would require good overlooking to ensure that the wash should be well got into all holes and corners, as these are the places which the Mites would most frequent, and which the whitewashers would the least attend to.

Where the Mites drop in the myriads noticed to the ground below, it would be desirable (and would cost little) to lay a strip of rough cloth or old oil cloth, or anything of the kind which might carry a good stripe of wet tar on it, just below where the Mites were dropping from. Thus any further annoyance or inconvenience would be prevented, at least from these; but with regard to clearing the infested Hay I have as yet no reliable information.

As the Mites dislike light and air and dryness, it would appear likely that if each day's fodder could be lightly shaken up into a kind of haycock some time before use, they would at least go down to the lowest part of the heap, and free the rest of the fodder. But this is only conjecture. Any practical means for getting rid of this infestation, which is disagreeable even if it is harmless, would be very desirable.

Stem Eelworm. *Tylenchus devastatrix*, Kuhn.



Young plant of Tulip-rooted Oats.

The diseased growth known as Tulip-root, or Segging, in Oats, is now so very well known both as to cause and methods found very serviceable both for prevention of recurrence of the attack, and to check it when present, that it hardly appears to require further notice. But from amongst the reports sent in during the past season I select just a few observations showing the great harm to the Oat crop sometimes caused by this attack.

As has been before noticed in this series of Reports, this disease consists of a sedge-like growth of the leaves, or a kind of bulb-like growth of the base of the stem of the Oat plant, with a number of minute pale crinkled shoots massed round the somewhat *Tulip*-bulb formed enlargement. These growths are caused by the presence of the Stem Eelworm, the *Tylenchus devastatrix*, of the attacks of which to Clover and to Field Bean plants, notes are given at pp. 16—22, preceding.

On the 9th of June, Mr. James Harper, writing from Auchnabo, Slains, Ellon (Aberdeenshire), mentioned that he was again troubled by Eelworms infesting an 8-acre field of Oats on the same land which was infested two years ago, and was the worst attack he had ever seen. "I think there is scarcely a plant escaping attack."—(J. H.)

On the 30th of June, Mr. J. Gathorne Wood, of Thedden Grange, Alton, Hants, forwarded me specimens of Tulip-rooted Oats with the remark that in one field he had several acres of Oats almost destroyed by the infestation.

The following observation sent early in August by Mr. John Hellaby, from Harlaston, near Tamworth, notes attack on a still wider scale, and gives an example of the patchy manner in which this kind of Eelworm attack often occurs, varying from infested spaces of several acres (as mentioned below) down to little spots a yard or so across scattered over one field.

The Tulip-rooted Oats sent were reported by Mr. Hellaby as being from a thirty-acre field on strong marl land, which was badly affected by the disease in patches, almost to not getting the seed again. In some parts of the field the crop was good, in others patches of two or three acres apiece were affected. The field had been sown with Oats and Clover after Turnips and Cabbage.

Mr. John Elder, of the Holmes, Linlithgow, whose yearly observations have greatly helped us to a knowledge of serviceable observations both for prevention and remedy of this attack, wrote me in a report on insect pests of the past season, sent in October:—"The Eelworm (Tulip-root) showed a little in some fields, but did not do any serious damage. In my own case I never had as heavy Oat crops, and the only portion that showed signs of Tulip-root was a small bit left unmanured. My manure was 1½ cwt. sulphate potash (55 per cent.), 2 cwt. phosphates mixed, and 1½ cwt. sulphate ammonia, per acre."

This mixture is the same in constituents, though with some slight differences in proportion as that previously found by Mr. Elder to answer extremely well in 1888 in keeping Tulip-root in check, and giving a luxuriant growth.*

Various experiments, with various results as to success or failure, were reported, but from the mixed nature of applications named (including, in some cases, what we know would certainly be useful, as well as what was very uncertain), to report these experiments would scarcely be of service.

Mr. J. Harper, of Auchnabo, above quoted, mentioned that he ploughed deeply (a most desirable preparation on infested land, Ed.), and also gave 1 cwt. nitrate of soda and 1 cwt. sulphate of potash; and the Oat crop at date of writing was fairly recovering and doing well towards a good return. In this case the sulphate of potash would, from the results of many experiences, do well; but, so far as I can myself judge, I should say previous experiments in this country did not point to nitrate of soda being a trustworthy remedy for Eelworm attack.

Notes on treatment of this attack, both by ordinary agricultural measures and by special applications, are given in my Reports from 1886 up to date; but as the yearly observations now show a constant increase in the number of kinds of plants liable to the infestation (notably Field Beans in this country, and Potatoes on the Continent of Europe), I repeat once again, from my 13th Report, the magnified figures of the male and female Stem Eelworm, the *Tylenchus devastatrix*, which I am permitted by the courtesy of Dr. J. Ritzema Bos* to copy from his figures drawn from life. These figures and the following explanation of the plate give all the details requisite for microscopic identification.

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* See 'Manual of Injurious Insects,' by Ed., p. 103.

EXPLANATION OF PLATE.

FIG. 1. *Tylenchus devastatrix*, female, taken from an Onion plant; magnified 200 times.

a, spear; *b*, first muscular swelling of the œsophagus; *c*, second œsophageal ring; *d*, *e*, intestine, properly so called; *e*, *f*, rectum; *f*, anal opening; *g*, excretory pore (orifice of the lateral vessel); *h*, commencement of the ovary; *i*, ovule, with nuclei (or germs), not fertilised; *k*, first half of the oviduct (tube), with spermatozoids; *l*, second half of the oviduct, with glands in the wall; *m*, anterior portion of the uterus, containing a fertilised egg; *n*, sac, with closed extremity, second portion of uterus; *o*, vulva.

FIG. 2. *Tylenchus devastatrix*, male, taken from an Onion plant; magnified 200 times.

For *a*, *b*, *c*, *d*, *e*, and *g*, see explanation of preceding figure; *f*, cloacal opening; *h*, commencement of the testis; *i*, mother-cells of the spermatozoids (Spermatoblastes); *k*, cells further divided, forming spermatozoids; *l*, vas deferens; *m*, spicule; *n*, accessory piece; *o*, purse.

FIG. 3. Anterior portion of a *Tylenchus devastatrix*, not fully developed, taken from an Onion plant; magnified 440 times.

For *a*, *b*, *c*, and *d*, see explanation of fig. 1. In front of the spear (*a*) is shown the labial region, and lower, at the base of the spear, the *musculi protractorii* leading forwards, and the *musculi retractorii* leading backwards. The half of the œsophagus in advance of the first bulb, or muscular swelling (*b*), has a straight direction; the half which extends from the first to the second muscular swelling is waved. In the second bulb nuclei are visible. Near (*d*) the intestine begins; in the wall of this the separate cells are not distinguishable, because of the presence of the numerous drops, which refract the light strongly.

FIG. 4. Anterior portion of a *Tylenchus devastatrix*, taken from a Wheat plant; magnified 440 times.

FIG. 5. Eelworms from Hyacinth, dried and rolled together.

FIGS. 6 & 7. Eggs of *T. devastatrix*, showing an early and late stage of formation of the embryo.

FIG. 8. The young wormlet (*T. devastatrix*) newly emerged from the egg.

FIG. 9. Egg of *T. devastatrix* before segmentation of protoplasm.

The figures on the plate are all greatly magnified. The life-size of the male and female is 1·5 mm., that is, a little more than the 25th part of an inch.

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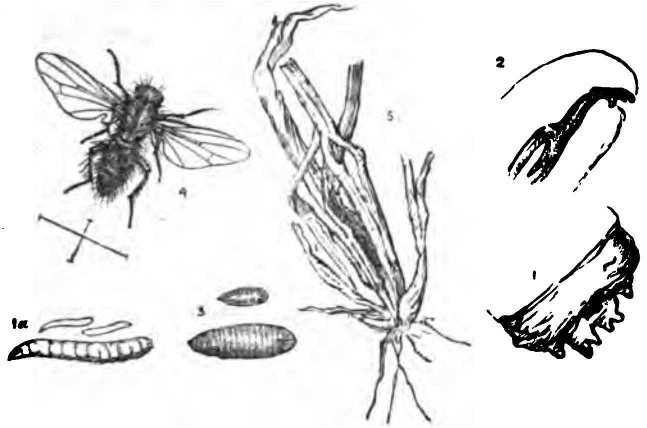
* See Plates I. and II. in 'L'Anguillule de la tige (*Tylenchus devastatrix*, Kuhn),' par Dr. J. Ritzema Bos, Prof. a l'Institut Agricole de l'État à Wageningen.

Wheat-bulb Fly. *Hylemyia coarctata*, Fallen.



Wheat-bulb Fly (*Hylemyia coarctata*), **magnified, and lines showing nat. size; maggots and chrysalids, nat. size and mag.; mouth apparatus, and extremity of tail, with tubercles, mag.; infested plant.**

During the past season, only a few observations of Wheat-bulb Fly were forwarded, but such reports as I received were from localities so far from each other as to show the infestation to be widely distributed, and they also showed that the kind of attack was the cause of very serious injury.

The damage is caused (as mentioned in previous Reports) by the small, whitish, legless maggots (figured above) feeding within the young Wheat plants early in the season, and so destroying the infested shoot; and, as the mischief that is going forward is rarely known of until attention is drawn to it by the withering of the shoot in which the maggot has been feeding, it is then too late to do much to help the failing crop.

The presence of infestation is noticeable at the beginning of April, or some weeks earlier. About the middle of May maggots may be found beginning to change to the chrysalis state in or near the decaying shoots ruined by their attack, and about the beginning of July, in such cases as I have seen, the fly makes its appearance. This may be generally described as a greyish hairy two-winged fly of the shape figured at the heading.*

Up to this time we do not know whether there is a second or summer brood. It does not seem likely that the flies which hatch out in July should live on to infest autumn and winter Wheat, sown, as for instance in 1889, at dates of which we have record in October,

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* For descriptions of the perfect insect and larva, see my 'Twelfth Report on Injurious Insects,' pp. 80, 81.

November, and at the end of December, "that sown on the 27th of December being afterwards entirely destroyed."

But at present all the clue we have to their summer habits is the fact noticed in the observations of each successive year of the special appearance of the attack after fallow, or bare or summer fallow, or after Turnips or Swedes, or where a portion of these have failed, or after Potatoes have been raised early, or had thin amounts of leafage. This inclines me to think that the summer attack may be in young plants of Couch or other wild Grasses, such as might be likely to grow on half-bare ground, or on fallows, in the condition in which I have at times seen them; but we have no evidence as yet on this point.

The first communication I had in the past season was from Mr. T. Spencer Smithson, of Facit, Rochdale, who wrote me on March 18th:—"The Wheat-bulb Fly, I am sorry to say, has again done serious damage in the same district of Lincolnshire as I reported to you last year." [This was on a farm at or near Saxilby, in a district a few miles north-west of Lincoln.—Ed.] "But this time the attack is more noticeable on Wheat sown after Clover and Rye-grass. This seems to me to afford some confirmation to your theory that the presence of Grass on the land previous to the sowing of the Wheat has some connection with the attack. The pest has apparently begun its ravages much earlier this year than last, and I am afraid the time has gone by for making satisfactory observations, as, when I was in Lincolnshire last week, the maggots themselves had disappeared."

On the 24th of April maggots, nearly or quite full-grown, were sent to me from Rochford, Essex, by Mr. Arthur L. Harrington, with the note:—"I send you herewith two or three maggots, which are found in the crowns of some Wheat on marsh lands; they are doing much damage. Can you give any account of them?"

A few days later, on the 28th of April, Mr. C. C. Harvey, writing from Foulness, Essex, forwarded specimens both of the *H. coarctata* maggots and of the Wheat which the maggots were destroying on his farm, with the mention that it was doing a deal of hurt on much of the marsh land on the Essex coast.

The following notes show the rapid change in an infested crop from the damage not being observable under special inspection, on the 4th of April, to severe injury, and half being destroyed by the 1st of May:—

On the 30th of April, Mr. J. Eardley Mason wrote me from Alford, Lincolnshire:—"On the 4th instant I inspected the Wheats upon the farm at Cumbermouth, near Alford, where *Hylemyia coarctata* did so much damage last year. I could then detect no visible signs of damage, but yesterday Mr. William Dring, the occupier, told me that precisely the same attack as last year has shown itself extensively in a field adjoining. It is after fallow again that the attack comes. Mr. Dring knows the form of attack and the maggot well."

On the 4th of May, Mr. Eardley Mason wrote to me further on the subject:—"I inspected the field at Cumberworth, which I spoke of. The change in its appearance is great. On the 4th of April a full healthy plant with no outward sign of attack; on the 1st May a scene of destruction. Over the greater part of the field one-half the plants are destroyed, and that past redemption. The larvæ were very nearly full-fed, but not many, I think, had pupated, for no puparia were found."

The above notes, it will be seen, refer to presence in the East of England. On the 2nd of May specimens of Wheat plants infested by the *H. coarctata* maggots were sent me from the South-west of England—from Corfe Hill, Weymouth—by Mr. E. B. Thresher, with the observation that the maggots were rapidly destroying the infested piece of Wheat. In this case the uninjured shoots were about or upwards of six inches long.

The observations forwarded this year do not help us to any further information as to means of dealing with this attack, but are of interest as showing the serious nature of the infestation; also its continued yearly appearance, and possibly the special presence in the marsh lands in Essex may be worth observation in connection with the report, sent to me in 1888, of hundreds of acres being destroyed by attack of this Wheat-bulb maggot in the Cambridgeshire Fens.

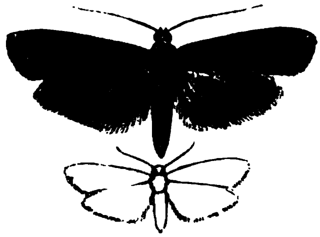
The following precise report of loss on infested crop, with which I was favoured by Mr. Michael Ellison, of Barber Woodhouse, on Dec. 27th, 1889, is a very serviceable addition, as being one of the definite records of direct loss by insect agency, which are so valuable to possess and so difficult to procure. I was sorry not to insert it in the year's report on Wheat-bulb maggot, to which it belongs, but the paper was then in type. I now give it in Mr. Ellison's own words:—

"In our correspondence last year respecting the Wheat-bulb maggot, in one of my letters I used words (quoted in your pamphlet) to this effect, 'I trust that the Corn that remains may yield more abundantly to make up for that which is lost,' . . . . It may interest you to know the result of the cropping and yield, which I have just lately learned from the tenant. From one field of 8½ acres there was no 'first' Corn; only 3 loads, or 9 bushels per acre, of 'seconds.' The other field of 12 acres yielded 16 sacks of 4 bushels each of 'firsts,' and of 'seconds' same as above, *viz.*, 3 loads per acre. You will see, therefore, that my wish expressed last year has certainly not been realised, and the results, as above described, show very forcibly what power for mischief the little maggot possesses."

The observations on "Mites" in Hay, and also on the "Flour Moth," the first of which attacks is sometimes very troublesome, and the second almost overwhelmingly destructive in mills and flour warehouses, are given for this reason, though not *growing-crop* pests.

FLOUR MILLS AND STORES.

Mediterranean Flour Moth. *Ephestia kühniella*, Zeller.



EPHESTIA KÜHNIELLA.

Mediterranean Flour Moth, magnified; outline showing natural size.

The "Mediterranean" Flour Moth (as it has now been named), the appearance of which as a most serious infestation in stores or Wheat flour mills, where it could gain entrance, was first recorded in this country respectively in 1887 and 1888, may now be considered to be thoroughly established, and quietly extending itself. From the natural and reasonable objection of all mill owners who are suffering from the presence of the pest to let the trouble be known of, the measures which are desirable to prevent spread of the evil cannot be made known, as is (for public good) highly desirable round the infested centres, and consequently infested meal or flour, and sacks passing to and fro, carry the infestation to neighbouring bakeries, or to more distant points, without the public at large being aware of what is going forward. In this matter my own hands are completely tied, as the requests for information regarding the attack which are sent to myself are sent in confidence, and consequently, however much I may know of the spread of the attack, I cannot give the warnings, which would be little short of ruin to the mill owners who have desired my help.

At present I am aware that at the steam mills where the pest was first reported as present in England it is still a very serious trouble, and, though much expense has been gone to in preventive measures, which have kept it to some degree in check, it is still seriously injurious.

On recent inquiry as to the state of things, I received the following reply from the owner:—"If it lay in my power I should be only too glad to assist in getting clear of the moths: unfortunately I *cannot.* They are here as bad, or worse than ever; so bad, in fact, that I have found it necessary to stop working my mill. I am at a loss to know what is going to be done if the pest spreads, as it seems likely to do.

"I happened some little while ago to be in a large warehouse belonging to one of the Canal Companies, where a very large quantity of grain, flour, &c., is trans-shipped, and I saw plenty of moths flying about there; in fact, I rather think I must have got them from there; so I fear there is little doubt but they will spread."

On the 5th of February, I received an application from a firm in the North of England, on the part of mill owners in a very large way of business in a distant part of the country, in which they mentioned:—"We would like to know how to get rid of the maggots of a small moth which is now becoming a serious practical nuisance in English flour mills. It is supposed that they first came here in a cargo of Russian Wheat, and are now taking up a firm hold in flour mills. Would sulphurous-acid gas be likely to kill them?"

After examination of specimens so as to ascertain that it was absolutely the *Ephestia kühniella* that was present, I forwarded information as to the best known method of treatment, and subsequently received a report from the proprietor as to partial success of measures used, and also misfortune occurring from over-application. These I give further on under preventive measures. But the result was by no means entirely satisfactory, as will be seen in the following letter, sent me on Nov. 9th, in reply to my inquiries:—

"I am sorry I cannot give you a receipt for getting rid of them entirely, nor much information about them. Cleanliness is a great enemy to them, of course, and we have not adopted any stronger measures since giving up the sulphur. I was recently told by some millwrights who were working for us that in some mills the plague is very much worse than we have had it. They mentioned a mill in" [locality named, ED.] "where moths were excessively numerous and troublesome.

"PS.—I was over several mills in Edinburgh and one at Dundee in July, but did not see any there." (Signed by head of mill firm).

The facts of the infestation being present at large steam mills in widely separated parts of England, it being in the Canal Company's warehouse, as above mentioned, my own knowledge of it being spread round one infested centre to the great annoyance of the neighbourhood, and various lesser observations, besides the overwhelming appearance first recorded in warehouses in East London, show the firm root the pest has taken.

Its geographical spread has been very notable. Last year it gained footing in Canada; and, whilst I write, I have received a communication from Dr. Selmar Schonland, Curator of the Albany Museum, Grahamstown, Cape Colony, in which he mentions inquiry having been sent to him from King Williamstown, regarding "a moth (or rather the larvæ) which do great damage in flour mills." Dr. Schonland was inquiring into the subject, but the probability, even, of the attack being this scourge on its still further advance deserves notice.

The moth is of the shape figured at p. 52, and of the size given in outline, the fore wings of a palish grey with darker transverse markings, the hinder wings whitish and semitransparent.

As it is of considerable importance to be able to distinguish the caterpillars of this well-named "mill scourge" from other less troublesome kinds, I repeat below the description which I formed carefully from living specimens in 1888.*

The mischief is caused by these caterpillars getting into every place where flour can fall, and spinning it together with their webs so as to cause a most serious difficulty in working the mills; in the words of one of my first correspondents, they "get into the spouts and machinery, and do no end of mischief, both by destroying the silks and stopping the flow of flour, &c., in the spouts by spinning their web and hanging there." In the report of the Canadian mill owners, in whose premises the pest was first found at work in Ontario (and to such an overwhelming amount that the mill had to stop work), it was mentioned the "mill-walls, ceilings, cracks, crevices, and every machine was completely infested with moths, cocoons, and caterpillars, and there was no use going on."*

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* The caterpillars varied in size from two-eighths up to five-eighths of an inch in length, and correspondingly in colour, the younger ones being of flesh or pale red colour, and the largest almost white; the shape cylindrical, somewhat slender, with sixteen feet, that is, three pairs of claw-feet, four pairs of sucker-feet, and a pair beneath the tail, by the help of which, although the largest of the larvæ were sluggish, the younger travelled nimbly, and could move backwards or forwards at pleasure, or were able to attach themselves at once to a foreign substance, as the finger or hand. The head yellowish brown, darker in front, and with dark brown jaws; a transverse patch on the segment next the head, this rather pale yellowish brown, with a faint pale central line dividing it from back to front, and (in the oldest specimen) a small brown spot on each side of the segment below the patch. Along the back, excepting towards the head and tail, were four small dark dots on each segment, above, two on each side the centre. On the segments near the head the spots were arranged more transversely, and at the tail, immediately above the sucker-feet, was a brownish oval or somewhat triangular patch (the anal plate). On the preceding segment the transverse row of spots varied somewhat in different specimens; the largest was in the middle, with a smaller one on each side, occasionally one below, which would make five altogether; but sometimes the lowest pair was absent, sometimes the middle large spot was not entire; conjecturally the marking differed with the age of the caterpillar. On the preceding, that is, the eleventh segment, there were two clearly defined brownish spots, and along each side of the caterpillar was a row of dark dots, one on each segment.

The caterpillar was slightly sprinkled with pale hairs or fine bristles, and had such a capacity for catching and retaining a covering of flour that I was obliged perpetually to remove it with the moistened tip of a finger to obtain a clear view of the markings.

The chrysalis, which was lying in a silken cocoon of spun-up flour, showed the chief points of the form of the coming insect plainly; the colour beeswax below, shading to reddish brown on the back, and reddish brown also at the end of the somewhat prolonged, slightly-curved tail, which ended bluntly or cylindrically; the eyes of a darker shade of red.—'12th Report on Injurious Insects,' by Ed.

In the account given in 1887 by Mr. Sidney Klein of the damage caused by this attack in some warehouses in the East-end of London, he mentioned that there were over a thousand tons of flour stored in close proximity, ... and "the attack spread with great rapidity until one entire warehouse was literally smothered with larvæ, and several hundreds of pounds' worth of damage was done."†

The above short descriptions of the appearance of the caterpillars and their methods of injury are merely given just to convey an idea of the nature of the infestations to those to whom the subject may be new. Details will be found at length in the publications mentioned in footnotes to this paper.

PREVENTION AND REMEDIES.—So far as we see at present, all that can be done in this way lies in the most extreme cleanliness, in fumigation, which, however, has to be done with much knowledge of chemical effects on flour that may be stored near by, and also in application of steam.

What would be the best remedy of all unfortunately appears to be impossible to bring to bear. The infestation takes this enormous hold because the proper food of the caterpillars is always present. If circumstances allowed of change of material ground, for a while, to some other kind of grain or seed on which the caterpillars would not feed, this infestation might very soon be got rid of; just, in fact, on the same principle as Mustard Beetle is got rid of when it has increased so as to be overly troublesome in the Mustard-growing districts in the East of England, by ceasing to grow the crop for a year or two. If the food crop or food material is removed, the feeder is necessarily got rid of, or much lessened in numbers.

Application of Hot Steam.—As, however, the above preventive measure could not be used, I suggested (from previous experience of the great serviceableness of turning on hot steam as a means of clearing out maggots from factories) that by means of hose attached to the engines currents of hot steam should be directed to every part that could be reached. This was on the first appearance of the attack as a mill-pest here.

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* 'Report on the Flour Moth.' Issued by the Ontario Department of Agriculture, October, 1889.

† 'Transactions of the Entomological Society,' pt. iv. December, 1887, p. lii.

This plan was carefully carried out; the mill was stopped working for a week, and after blowing the steam, which took two or three days, the men were set to wash the walls (where it could be done without risk of affecting the taste of the flour) with paraffin, and the insides of the machines were washed with a strong solution of soda and water. This solution was mentioned as being very effectual in destroying such of the maggots as it reached. These costly and troublesome measures did much good temporarily, but were by no means a permanent cure.

On the first observation of this very serious infestation in Canada, attempts were made to clear the mills by stopping work again and again, and cleaning down as carefully as possible, but totally without any benefit. It is especially mentioned that they took the clothing from the bolting-reels and cleaned it, and washed the inside thoroughly with soft lye-soap and lime, and did the same with the elevators. "When we started up again every corner and part of the mill had been thoroughly cleaned as we supposed, and we commenced to work again; but after about four days we found our bolting-reels, elevators, &c., worse than before. This went on till the case was considered hopeless, without more stringent measures, and the machinery was taken down and subjected to thorough steaming. Also the mill was swept down and subjected to sulphur-fumes. The walls, ceilings, &c., were cleaned, and elevator-spouts and loose wooden work burnt up. Paper bags and hundreds of dollars' worth of goods were burnt in the furnace; while the other bags, elevator-belts and cups were boiled for hours in a cauldron of water. The machines and parts that were not destroyed were then burnt by means of a kerosene torch, which flamed and smoked through and around every part of them, until we considered we had everything clean and ready for putting together again."

These arrangements, however, were not considered sufficiently stringent to meet the great emergency, and under an order in Council, approved by His Honour the Lieutenant-Governor, further measures to allow of more powerful application of steam pressure for purification of the machinery were carried out as follows:—

"We at once constructed a tight steam-box, 6 ft. wide, 6 ft. high, and 12 ft. long, and attached a steam-pipe to it from the boiler. In this box we put every machine, and even our mill-stones and iron rollers. This process was very expensive, and took considerable time, as we were over a week at the process, and were delayed in the placing of our machinery. The Board of Health visited us in a body during the time this process was going on, and pronounced it a success. This was all done not only in our own interests, as was pointed out in a letter of the 20th September from Dr. Bryce, but in the interests of the public health and commerce of the country.

"Having now got to the position which enables us to go to work again after two months' loss of time, and the loss of machinery, fixtures, stock, and expense, we have arranged for remedial measures to prevent the reappearance, or destruction of the pest should we ever be again attacked. We have erected a steam standpipe, with hose or other connection, on each flat of the mill-building. By shutting up all doors and windows of each flat and turning on steam simultaneously to each floor, the whole building can be filled with hot live steam sufficient to kill anything. This will rust all bright parts of the machinery, but to remedy this we intend using oil on them should we ever be under the necessity of resorting to the measure.

"Another purpose of this steam standpipe will be, in cold weather, to let on sufficient steam to moisten everything, and part of the building at night, and then throw open the windows for the night, and let the frost penetrate so as to kill any eggs or insects that may have become lodged in unseen parts.

"By these measures, with plenty of light, thorough cleanliness, a cold mill, and caution in taking in stock and old bags, we hope to keep free of a pest which has given us so much trouble and loss."*

Fumigation and Cautions to be observed.—The use of sulphur and other kinds of fumes may be turned to very good account in lessening the amount of infestation, at least for the time being; but it should be borne in mind that these fumigations must be given with careful consideration as to amount used in given space, or, where the mills are also used as stores, much injury may be caused to the flour standing in sacks.

On this subject I was favoured, on the 8th of June, with the following letter from the owner of some large steam mills which were badly infested:—

"During the months of April and May, we have on several occasions fumigated the mill with sulphur, as recommended in your Report for 1888, on each occasion being more or less successful in destroying the moths, which have during this warm weather especially infested the place. We started first of all with one fire in the bottom of the building, and burnt about 28 lbs. of sulphur. This quantity we found did not have very much effect, and we from time to time increased the amount, till at Whitsuntide, on the Saturday, Sunday, and Monday, we burnt in two fires about 500 lbs. of sulphur, and thus did good execution; but yet some live ones were found on the Tuesday morning, when the man went round to sweep up the dead ones. We thought these must have hatched out the night before perhaps, and so not have had the benefit of the three days' fumigating.

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* Report previously referred to, being 'Bulletin I. of Provincial Board of Health of Ontario. The Flour Moth, *Ephestia kühniella*.' Issued by the Ontario Department of Agriculture.

"But we found that the sulphuring has an effect which we did not anticipate or wish for. We had standing in the mill itself, when the fumigation was carried out, some 80 or 100 sacks of flour, and we find to our dismay that the sulphur has penetrated right into these, and acted on the gluten of the flour in such a manner as to apparently break it up into soluble albuminoids, and render the dough made from it more like a lot of weak putty than the 'strong' tough dough our customers require.

"After noticing this change in the flour we tried exposing a small quantity to the fumes of burning sulphur in a small room, and found the result was the same.

"The effect would be very disastrous to millers who store their flour in the same building as they manufacture it in, as some do; and in our case it has given a lot of trouble. I think you will be glad to know of this, that you may warn your correspondents against sulphuring any building containing large quantities of corn."

I most particularly beg to draw the attention of all troubled with this infestation to the importance of the above observation, and, having given this necessary caution, which I owe to the courtesy of a large steam-mill firm, I extract from the Canadian Government Report, before referred to, some of the methods advised for applying fumigation, and also the strengths specified:—

"To destroy the moths. This can be done by closing the windows, doors, or other apertures of the building, and night after night, until all evidences of moths have disappeared; burn sulphur by placing it in shallow pans upon a number of heated stoves, say small coal-oil stoves, in different parts of the building, and putting a match to it." The note below describes another convenient method of creating sulphur dioxide fumes.

Note.—"To prepare sulphur fumes. Place a metallic dish containing hot ashes on some support in a pan of water, or place in an old pan or other vessel a bed of ashes at least 6 in. deep and about 15 in. in diameter, and place the sulphur and saltpetre in a slight depression in the centre and ignite.

"The proper proportions are 8 lbs. of sulphur and 8 ozs. of saltpetre per 1000 cubic feet of air space. All doors, windows, and other openings should be tightly closed before the sulphur and saltpetre are ignited."—Page 12 of Canadian Report.

"Chlorine fumes may be used with equal benefit under those conditions where burning sulphur may create an added element of danger from fire."

Note.—"To prepare chlorine fumes. Mix in a glazed dish and place on a stove or other heating surface peroxide of manganese 1 part, sulphuric acid 2, chloride of sodium 3, water 2; or, more easily, by mixing 3 lbs. of chloride of lime and 3 lbs. of hydrochloric acid for every 1000 feet of space."—Page 14 of above Report.

"In burning the sulphur we find the best method is to get old tarred string, such as used for tying up the sacks; put this in a large iron tray and light it before adding the sulphur. The addition of paraffin is also a help, but is, of course, not safe in all places. When well alight add the sulphur. We tried charcoal, but could not get on with it, or shavings."—Communication sent me from infested English steam mills, June 8th, 1890.

General Measures of Prevention.—This infestation may be transmitted with the utmost ease by caterpillars being sent out in flour, or by eggs on sacks. Besides all the troubles that occur in mills and stores, where these caterpillars establish themselves, I am aware of infestation occurring in the neighbourhood, to the great perplexity of all but those who knew whence the pests came.

For this reason it is of the utmost importance that those who wish to keep clear of infection should keep a watchful eye on flour and returned sacks, and, if they have a doubt as to attack being present, then gain a trustworthy opinion as to the nature of what they find.

In the Canadian directions for treatment, it is noted that all bags which have been used for transporting grain, flour, or meal, and which from causes specified are liable to suspicion, should be subjected to thorough boiling, or to superheated steam. The best method to disinfect the sacks or bags may be safely left to millers, but some treatment of exposure to dry or wet heat is certainly needed (where infestation is about) to destroy caterpillars that may have remained inside or outside the bags, or eggs which the moths will have been exceedingly likely to lay outside the meal or flour sacks. These precautions are needed for home use; it is quite too late now to hope to be able to keep the infestation out of the country.

The following general directions (or rather summary of directions) for action on the very first appearance of the moth, and for remedial measures to be brought to bear on infested apparatus, are taken from the Canadian Report before quoted:—"Have the first moths appearing destroyed by hand, and by subjecting the affected portions of a mill or building to repeated treatment with the fumes of burning sulphur every night when the works stop. If this be persistently followed out but little development of new forms will take place. It must be remembered that this work must be persistent and thorough; abundance of sulphur burnt, again and again, being the sufficient condition of success.

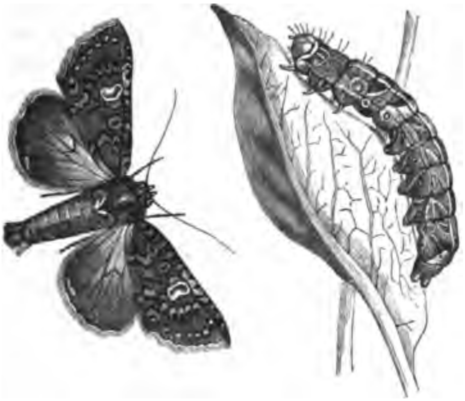
"Where, however, the larvæ have, as it were, gained possession of bolting-cloths and carriers, treatment with steam under pressure driven throughout all parts of the bolting-cloths, carriers, and other machinery has been found very useful in lessening the inconvenience from the spinning of webs, and thereby the clogging of the machinery. The walls, floors, and ceilings may further be treated with advantage by first brushing down all dust, and thereafter spraying them with a solution consisting of a drachm of corrosive sublimate to each gallon of water by means of a gardener's force-pump. Treatment with fumes from burning sulphur while parts are yet moist from this washing down will greatly aid in the destruction of any larvæ or cocoon forms which may be reached."

Instead of corrosive sublimate a wash formed of soft-soap, water, and paraffin may be used, and applied by a gardener's force-pump. There is considerable difficulty in making the mineral oil and soap wash unite permanently, but if, instead of a force-pump, a large pail was used and the mixture distributed by hand with a syringe, this difficulty would be got over, for the ingredients in the pail would be, or could be, perpetually remixed by repeated action of the syringe. A proportion of 2 gallons of kerosine (or paraffin), 1 gallon of water, and ½ lb. soap, either common or whale-oil or soft-soap, when *properly* churned by a force-pump and spray-nozzle for five or ten minutes, makes a kind of cream. This should be diluted for use at the rate of 1 gallon of the emulsion to 9 of water.

In the foregoing paper I have repeated some small proportion of information from my previous Reports, and given the most important points of the treatment which has proved serviceable at home, and was adopted and much amplified in detail and improved in application in Canada. At present the very seriousness of the infestation is, I know, causing its increase, for no firm suffering under the trouble is willing to let the trouble be made public. But this at least I may say: I have carefully preserved the confidence reposed in me hitherto, and if in the future any firm will be so very kind as to place in my hands any information of measures which are more effective than the partially successful and costly arrangements which, so far as I know, are all that have been tried at present, I would very thankfully make this information public, with the utmost care (unless permitted otherwise) to give no clue to the name or locality of the contributors.

GOOSEBERRY.

Dot Moth. *Mamestra persicariæ*, Linn.



MAMESTRA PERSICARIÆ.
Dot Moth (from life); caterpillar (after figure of Dr. Taschenberg's).

The *Mamestra persicariæ*, or Dot Moth, is very common and widely distributed in England, as well as in various parts of the Continent (notably Germany and Holland); but, although the caterpillar is a very general feeder, as well as very common, it was not until the past season that observations were sent to me of its workings.

On Sept. 27th, I received specimens of the caterpillar, accompanied by inquiries as to the nature of the attack and means of prevention, from correspondents at Leicester. They mentioned:— "We have discovered an unusual visitor at this time of the year in Gooseberry and Currant bushes, as a very active and destructive caterpillar (of different shape and colour), which divests the bushes of all their leaves."

The specimens gave good examples of the marked variety of colouring which sometimes occurs in the case of this kind of caterpillar. One was rosy brown with brown markings, the other was rather smaller and of a green ground colour.

The figure above gives a good idea of the shape and markings, and also the size when fully grown, of these caterpillars. The head is pale, and sometimes partially withdrawn into the next segment, which has a dark patch on the back, divided lengthways down the middle, and also bordered on each side by a white line, and a pale white line runs down the back. On each side of this line, beginning at the 4th segment from the head and continuing to the 11th inclusive, is an oblique darkish mark on each side of each segment; these slant backwards so that the pair meeting at the centre of the back form a series of V-like markings, with the point of the V directed backwards. The foremost pair of these markings, as shown in the figure, are the darkest. Beneath these oblique marks is a wavy stripe running along the side, and beneath this again are five oblique bands (slanting in the opposite direction to the uppermost row), of which four run down the sucker-legs. The length, when full-grown, is an inch and a half or rather more. It is to be found in summer and autumn, and when full-fed, which may be towards the end of September, buries itself in the ground to go through its changes.

On Sept. 30th I was favoured with the following notes of observation of attack by Mr. Oliver E. Janson, F.E.S., of Perth Road, London, N.;—"The larva of *M. persicariæ* has been exceedingly abundant and destructive to the leafage of various plants, including Gooseberry, in my own garden this year; there are still many left, although I have destroyed a great number. The variation of colour is very striking, especially the extremes you mention (rosy brown and a beautiful green)."

To this, later on, Mr. Janson added the following note, which is of practical interest, as showing the very great number of caterpillars present, the variety of plants they attacked, and also their great variety of colour:—

"Although I believe insects generally have been remarkably scarce this year, the caterpillars of some of the Lepidoptera have certainly been exceptions, for, besides an unusual quantity of *Pieris rapæ*, *Spilosoma lubricipeda*, *Abraxas grossulariata*, and *Mamestra brassicæ*,* the gardens in this neighbourhood have suffered severely from the ravages of the caterpillar of the common 'Dot' Moth (*Mamestra persicariæ*), which made its appearance in extraordinary abundance about the middle of August, and lasted up to the end of September.

"In my own garden, although I destroyed some hundreds of them, their numbers seemed in no way diminished, and almost all plants were attacked by them; but Lettuce, Parsley, Mint, Gooseberry, Geranium, and Marigold they appeared particularly partial to and entirely devoured, and some, which were kept in confinement in a larva-cage, I found would feed as readily on Apple and Poplar as any other kind of plant. The colour of these caterpillars varies very much, and when full-grown some of the varieties are so beautiful that one almost feels reluctant to destroy them; the peculiar shading of the markings of various tints of green, grey, or brown render them very difficult to detect when at rest in the daytime on the stems or leaves of the plants." This point is important economically, and so is that of their sudden disappearance. On the 2nd of October my correspondent at Leicester above mentioned wrote that the large caterpillars on the Gooseberry bushes had "vanished as if by magic." But they are only buried, and from the dark brown chrysalids beneath the surface the Dot Moths will make their appearance (unless measures are taken to the contrary) about the end of June, or possibly earlier, next year and start new attack.

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* Popularly the Small White Cabbage Butterfly, Buff Ermine Moth, Magpie or Currant Moth, and Cabbage Moth.

The moth is of the size figured (p. 61). The fore wings of a rich dark brown or black ground colour, varied with chestnut or rust colour, and small pale spots or flecks at the tips and near the hinder edge, and also bear a conspicuous bright white patch or "dot" (of the shape figured near the centre), from which the moth takes its name. The hinder wings have the lower half pale with a broad dark smoky band towards the margin, and the nervures very observable.

The caterpillar feeds on many kinds of plants, especially on Elder. Amongst field-crop plants it is to be found at times on Mangolds and Hops. It preys on Raspberry, and is noticed by Dr. E. L. Taschenberg as also, in the year 1871, being found on orchard trees. From the lists of its food plants given in different publications and by different observers it is obviously a very general feeder, and amongst the weed plants that it infests is "Knot Grass" from one kind of which the moth takes its specific scientific name.

PREVENTION AND REMEDIES.—No better plan than hand-picking seems to be known of for getting rid of the caterpillars from off the plants. Recurrence of attack in the following year from presence of chrysalids in the ground during the winter may be prevented or much lessened by stirring the soil so as to turn them up to the surface. The exposure to weather, especially to alternate frost and wet when not in their naturally arranged shelters, may be expected to kill at least a large proportion of them. Removal of the weeds which the caterpillars especially prefer for food would also be likely to be beneficial.

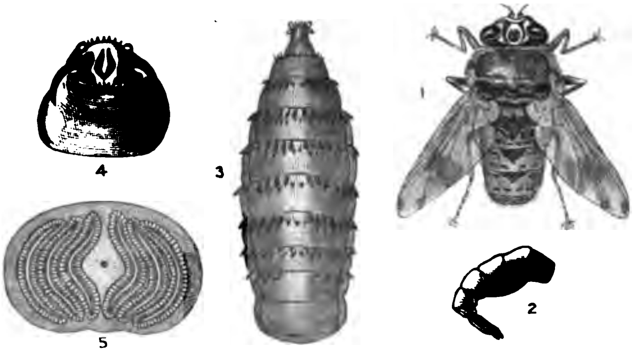
Syringings and dusting which would make the leafage unattractive to the caterpillars could not fail to do good. Probably soft-soap and sulphur washes such as Burford's compound, mentioned at page 8, would be useful. Or spraying the infested bushes lightly, so as just to damp the surface, and then dusting well with soot, or with a mixture of soot together with quick-lime, gas-lime and sulphur all very finely powdered together, would do good; or this might be applied when the dew is on.

In cases like this a thorough good drenching of cold water may very likely do all that is needed. If the caterpillars fall off with the shock, they can be killed by being trampled on, and there is also a good chance that the cold water (with them, as with some other moth caterpillars) would bring on such violent purging that they would very soon be reduced to mere skins.

It would at least be worth while to try some of these regular methods of dealing with caterpillar attack, as little appears to be recorded regarding preventive treatment of this special kind.

HORSE.

Horse Bot Fly; Horse Bee. *Gastrophilus equi*, **Fab.**



Gastrophilus equi.

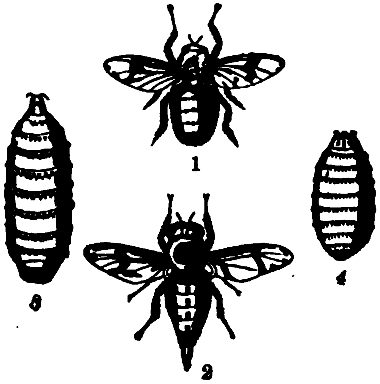
1, Horse Bot Fly, male; 2, curved extremity of abdomen of female; 3, maggot; 4, mouth hooks; 5, spiracles at extremity of tail of maggot, all greatly magnified after Brauer, nat. size given in descriptions.

The history of Horse Bot Fly attack has been well known for many years, probably there are few insects of which the habits have been known correctly for so long a time, but still this knowledge is not nearly so widely spread as is desirable, and enquiries as to the nature of the attack, and amount of mischief to be feared from it, are sent me regularly year by year.

I have therefore, according to desire, now given (just for use of those who have not the standard works on the subject at hand) a short description of this infestation, partly from my own observations of the specimens forwarded, which have given me the opportunity of seeing this Bot Fly (or "Horse Bee," as it is sometimes called) in all its stages, as well as the manner in which in bad cases the larvæ fairly coat, or pavement over, the infested part of the stomach, and partly from descriptions by Bracy Clark,* and German entomological writers up to date.

With regard to some of the internal characteristics of the infestation, I am able to give some amount of reply to the enquiries most frequently made, by extracts precisely bearing on these points from a paper by Mr. D. Hutcheon, C.V.S., Government Veterinary Surgeon, Cape Colony, and also by some observations placed in my hands by Mr. Hy. Thompson, M.R.C.V.S., Aspatria, Cumberland, who has also favoured me by the important assistance of revising this paper before publication.

This attack is widely distributed. It is found all over Europe, in widely separated parts of Africa, notably at Cairo and the Cape of Good Hope, and also in Asia and North America.



Horse Bot Fly, 1, male; 2, female; 3, maggot; 4, chrysalis, nat. size, after Bracy Clark.

The flies are from half an inch to two-thirds of an inch in length. The male with the end of the abdomen blunt, the female with it prolonged, as shown in the accompanying figures, and also at p. 64, where a side view of the ovipositor as curved under the body and much magnified, is given. The colour may be generally described as yellowish brown with black or dark markings (as shown in the figures) on the body between the wings and down the abdomen. The somewhat shaggy hair is very various in colour, being black or brown or yellowish or whitish, so as to make it difficult to describe the colouring clearly; in the specimen before me it is much varied with chestnut or foxy colour on the abdomen.† The long ovipositor of the female is of a shining black brown.

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* Essay "On the Bots of Horses and other Animals," by Bracy Clark, F.L.S.

† For minute description of colours and details, see 'Monographie der Œstriden,' von Friedrich Braner, pp. 69—71, and also, for the above and life-history, 'Praktische Insekten Kunde,' by Dr. E. L. Taschenberg, pt. iv., pp. 73—76.

The two wings are moderately large, closed together when at rest, hyaline, sometimes opaque white; with a transverse brown or grey band and two spots, or a slight marking at the tip. The legs are long in proportion, smooth and mostly yellowish brown. The fly is known by the various names of the Great Spotted "Horse Bot Fly"; the "Horse Bee"; and also, from one of the places it selects for egg-laying, as the "Knee Bot Fly."

In Europe the fly is to be found from June or July until October. It is of some interest to note that, in the observations of the veterinary surgeon of Cape Colony, the time of the deposit of the eggs varies from what it is here correspondingly with the different time of year of the summer season in that part of the world. He found egg-laying to begin about the beginning of January, and to continue until about the end of April.

The eggs are hardly the twelfth of an inch long, white, spindle-shaped at one end, and obliquely truncate at the other, and are attached by the female Bot Fly to the hairs of the Horse. The hair of the mane, the shoulders, and the inside of the knee, are places especially chosen for egg-laying.

Eggs of Horse Bot Fly, nat. size and magnified, after Bracy Clark.

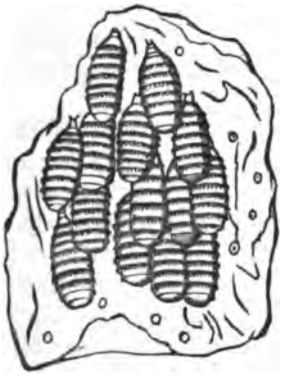
The method of deposit is for the fly to poise near the Horse, and then flying at the spot to leave the egg fixed to the hair by a glutinous moisture, and so to continue until four or five hundred eggs may be laid on one animal. Her whole supply is stated to be as much as seven hundred.

These eggs are ready to hatch in a period variously stated as from about five days to three weeks, but the maggot which then emerges is *not* at first of the shape figured (p. 65), which it gradually grows to, but very much narrower in proportion, more like a short worm, smallest at the tail end and gradually increasing in width till about the fourth ring from the head, or anterior extremity, and then quickly lessening again. How these maggots are conveyed into the Horse does not appear to be an absolutely settled thing; some *may* possibly creep through the hair to the mouth. The most commonly received opinion however, is, as given by Dr. Cobbold and others, that the moisture and warmth from the Horse's tongue when he licks the spots where the eggs are attached hatches them, or, rather, helps to free the maggot if near hatching time, and the maggot being produced adheres to the Horse's tongue. Thus some amount of larvæ from the many eggs laid are conveyed into the mouth whence they pass downwards, or are carried downwards with food, &c., from the mouth to the stomach.

On the above points I was favoured with the following practical observations by Mr. Hy. Thompson, M.R.C.V.S., of Aspatria:—"I have never seen or known of the small insect after being *hatched* on the legs, shoulder, or sides of the Horse, creep along the body to get into the mouth. The shoulder and inside of the knee and foreleg generally are the places where we find the eggs are most frequently deposited, being naturally the most suitable situations, and, from the heat of the Horse's body, I think the ova are hatched there, causing a tickling sensation in the part which the Horse licks with his tongue, and the small creatures are carried into the stomach with food and the secretion of the mouth."—(H. T.)

There the maggots fix themselves to the mucous membrane by means of two dark brown hooks (see fig. p. 64), one of which is placed on each side of the slit which serves for a mouth, and there they nourish themselves by suction. As they grow older they alter in shape to that figured at p. 65 (and much magnified as at heading, p. 64), and are considered to pass from 8 to 10 months in maggot state, attached by their mouth hooks to the lining membrane of a portion of the stomach.*

Sometimes there may be only a few of these maggots present, sometimes (as I have seen them myself) they are present in such numbers as to lie close up against each other over a large patch of surface, so that it hardly seemed possible to find room for another amongst them.



Maggots or Horse Bots attached to membrane of stomach, after Bracy Clark.

The above figure shows a number of partly grown Bot maggots attached to the membrane of the stomach. By this time they have gained their characteristic form, which is somewhat barrel-shaped, banded round at intervals by lines of prickles or horny points. They are widest about the middle, rather smaller at the tail extremity, in which are the spiracles or breathing apparatus figured, magnified, at p. 64, and diminishing more quickly towards the anterior extremity, in which are the mouth hooks figured, magnified, also at p. 64.

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* For detailed remarks on this characteristic of the attack which is very important, see observations further on.

The maggots are of various shades of flesh colour; when full grown they are yellowish flesh colour and about three-quarters of an inch or rather more in length, and about a third of an inch wide at the widest part.

The time passed in maggot condition is about 9 or 10 months or possibly more. When full grown they loosen the hold of their mouth hooks, by which they have kept themselves in position, and passing along the intestines are discharged from the animal, and fall to the ground with the rejectamenta.

They bury themselves in the Horse dung, or in the ground, and there turn to brown chrysalids (formed outside of the hardened skin of the maggot), from which the fly comes out in about six or seven weeks during summer.

Prevention and Remedies.—Combing, brushing, clipping hair at the infested spots, and the use of soaps and washes, which would not be in any way injurious to the Horse, whilst they would help to clean off eggs and hatching maggots, are amongst the regular methods of treatment. Any safe wash or smear with strong carbolic or mineral oil smell, or any other scent obnoxious to the flies would of course be a deterrent of attack. Also (looking at how strongly the point is brought forward that the united *warmth* and *moisture* of the Horse's tongue promotes hatching out of the maggots), warm washings which open the eggs, and clear or kill these maggots as they hatch, might be expected to be of use.

If the flies as a rule do not follow the Horses into stables, it would of course be of some preventive service where animals were out at grass (and it was desired to preserve them from attack) to have sheds into which they could go in the heat of the day, when annoyed by fly attack.

Also, where the yellowish pink maggots, or brown chrysalids which are much like them in shape, are in such numbers as to be noticeable in the Horse droppings, it might be desirable to attend to this matter in any way which would most conveniently destroy the infestation.

With regard to season of attack and some methods of treatment, Mr. Thompson remarked:—"Haytime (July and August) is the time most noted in the north for observing the ova deposited on the Horse; there is no rubbing them off. They are firmly fixed—glued to the hair. To prevent development, Horses at work could have the ova scraped off and the parts rubbed with turpentine, and animals at grass could be brought in once a fortnight, examined and treated in the same way."—(H. T.)

Some of the points especially brought forward for notice in enquiries are the amount of injury supposed to be shown by the state of the membrane from which the maggots have been removed, and also the idea that a great hole or perforation has been caused by the maggot attack. As these points are not what I could give an accurate opinion on, I have never offered any observations on them to correspondents beyond recommending application for proper veterinary advice, but during the past season the following observations given on these points, by Mr. D. Hutcheon, C.V.S., Government Veterinary Surgeon, Cape Colony, reply so clearly and precisely to these enquiries that I give them (duly acknowledged), followed by the observations with which I have been favoured by Mr. Hy. Thompson, M.R.C.V.S., of Aspatria.

The following observations are from the 'Agricultural Journal,' published by the Department of Agriculture of Cape Colony, No. 34, pp. 278, 279.

The situation of the Bots in the Horse's stomach.—"A great deal of misunderstanding, with reference to the injury which the Bots inflict upon a Horse's stomach, arises from the fact that few non-professional men are acquainted with the normal appearance which it presents. When a Horse's stomach is opened, one is at once struck by the different appearances presented by its internal membrane according as it is examined to the right or left. To the left, where the gullet enters, the lining membrane has a pale white appearance, and is firm and resisting to the touch. This white and resisting lining terminates in the centre of the stomach by a distinct wavy ridge. Beyond this ridge on the right side, which terminates in the opening to the intestines, the lining membrane is of a purplish or reddish brown colour, very vascular and appearing inflamed when compared with the white lining membrane of the left side. It is this division of the mucous membrane lining of the stomach of the Horse into two distinct portions which have led amateur anatomists astray.

"I have observed this peculiarity at every *post-mortem* examination of a Horse which I have made in the Colony.

"On cutting open a stomach, emptying and cleaning it, so as to exhibit its general appearance and the position which the Bots occupy, it is very rare that some one amongst the by-standers does not call out, 'There you are! Don't you see the Bots have eaten off half of the lining of the stomach!' They observe the Bots sticking in a close cluster on the white membrane which lines the left or gullet-end of the stomach, and on comparing this part of the stomach to the other end, which terminates in the intestines and has a reddish raw appearance, exactly as if the white lining had been torn off from it, the conclusion arrived at—and a very natural one too—is that the Bots have already eaten off the white lining on the right end of the stomach, and are about to commence operations of a similiar character on the left.

"Another source of error is the fact that each Bot pierces a small hole about the size of a pinhead through the white lining of the stomach. If the Bots are pulled off, the part of the lining where they were clustered looks like a sieve. Although I have even seen Bots burrow through between the inner white lining and the muscular layer of the walls of the stomach, when the *post-mortem* examination was delayed for some time, I have never seen any inflammation about these holes, neither have I ever seen the stomach pierced right through as many have asserted. Were any of these large holes made before the animal died, there would be a raw vascular appearance about the edges of these holes which as stated I have never observed, clearly indicating that any piercing, beyond the small pinhead holes which always exist while the Bots are there, took place after the death, when the Bots began to move about.

"Another error, which I have seen more than one farmer make, is to mistake the hole made by cutting off the œsophagus for a hole pierced by the Bots. This misconception arises from the fact that the Bots are very often clustered immediately around the entrance of the gullet into the stomach. When the stomach is thus cut out as usual, by cutting off the gullet close to the stomach, and the stomach is afterwards opened carelessly, that opening made by cutting off the œsophagus is frequently mistaken for an opening eaten through by Bots, since a few Bots will generally be found on the outside of the hole, and others in the act of passing through it. I have opened very many Horses in this Colony which have been certified to have died from Bots, but I never saw a case in which there was the least evidence that the Bots had anything to do with the animal's death." *

Further on in the above paper the writer remarks with regard to suggestions, "whether the presence of the Bot maggots may not seriously interfere with the Horse's digestion by destroying the healthy functions of the membrane to which they are attached"? . . . . "the portion of the stomach to which the Bots are attached is lined by a strong white mucous membrane, which contains no gastric glands, but is covered by a thick layer of epithelium which protects it from injury. Bots do not therefore interfere directly with the gastric digestion of the Horse. It is the other end of the stomach which contains the gastric glands and which performs the whole of the digestive process carried on within a Horse's stomach." †

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* "Diseases of the Horse," by the Colonial Veterinary Surgeon, 'Agricultural Journal,' published by the Dept. of Agriculture, of the Cape Colony, No 34, Dec. 12, 1889.

† Paper on "Diseases of the Horse," previously quoted.

The following communication with which I was favoured by Mr. Hy. Thompson, is to the same effect. He observed that the young Bot maggots "are carried into the stomach with food and the secretions of the mouth and deposited on the anterior or cuticular portion of the stomach.

"The stomach of the Horse has two linings, one half is cuticular, the other villous, or true digestive portion. I have seen a large number of cases but never saw the Bots attached to villous portion. Possibly the gastric juice (hydrochloric acid) is too strong, and destroys them in this portion before they become attached? Again, where the Bots are attached, the parts or walls of the stomach are thickened.

"I have never seen the stomach entirely perforated, but the irritation induced by the development of the larva causes in many cases a great wasting of flesh in the Horse.

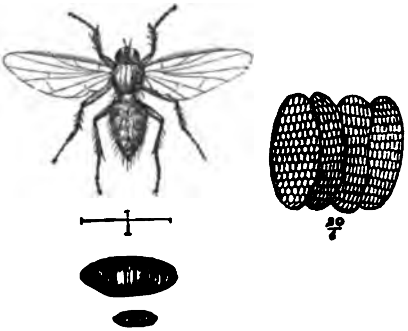
"I know of no medicine that will destroy them, or make them leave their winter quarters until fully developed. A good feed of grass in early spring induces them to detach themselves the soonest, but I am inclined to think the larva will hold on till fully developed before leaving.

"As a medicine, 2 ozs. turpentine and 20 ozs. of raw linseed oil mixed, and given as a draught once a fortnight is the best remedy; *i. e.*, if it is thought the loss of flesh and condition of the Horse is due to the presence of Bots."—(H. T.)

In offering the above paper I have done so with some hesitation, as being quite outside my regular work on *crop* infestations. But some information about this attack has been so much wished for by those who have no opportunity of consulting standard works on the subject, that to the best of my power I have described the life-history of the insect (with which I am necessarily well acquainted). On the internal points so often erroneously thought to show great injury, I have ventured to lay before my readers the opinion of two well known veterinary surgeons. To those who desire further information, I believe I could give any details required, bearing simply on the life-history of the insect itself; the anatomical and veterinary points they would doubtless gain all information on from their veterinary advisers.

MANGOLDS.

Mangold or Beet Fly. *Anthomyia* (*Chortophila*) *betæ*, Curtis.



A. betæ (female), mag.; line showing spread of wings, nat. size; pupa, nat. size and magnified. Eggs (after Farsky), mag.

During the past season Mangold-leaf maggot has, as usual, been doing mischief. This, as for the most part is well known, is a small whitish, legless maggot, which feeds between the upper and under sides of the leaf. Thus blister-like patches are formed where the substance of the leaf has been destroyed, and, according to whether these are few or many, so is the amount of injury done. Sometimes (especially when the crop is attacked when young) the greater part of the leafage is destroyed.

The maggots feed for about a month in the leaves, and then turn to chrysalids (usually in the ground to which the maggots have fallen from the leafage above). From these chrysalids the greyish flies soon appear, so that there may be a succession of broods during the summer, and the damage through injury to the Mangold or Beet leaves is at times very great.

The history of this attack, and such measures of prevention and remedy as have appeared serviceable up to date, have been so often given that it is unnecessary to repeat them; but the great difficulty has been to gain knowledge of some kind of dressing that it was possible to apply, and which might be depended on as a beneficial application to the crop when badly injured.

Notes have been given of good effect from applications of guano, also of soot, and of mineral superphosphate, the effect of the superphosphate in this set of parallel experiments being the best.

But the most markedly good results were given by nitrate of soda, sown between the rows just before showers, which answered excellently in bringing Mangolds, of which the leafage had been almost destroyed by the maggot attack, well round, and giving a good crop of roots.

I was also favoured with notes by Mr. Jabez Turner, of Norman Cross, Peterborough, showing the benefit of autumn manuring and working of the ground, thus securing such a good tilth and condition of land at sowing-time as will force the plant on past ordinary fly-attack.

In the past season experiment was made, at Rothamsted, as to effect of application of nitrate of soda to a crop of badly-infested Mangolds. This was attended with such marked success that I requested permission of Sir John B. Lawes to publish a note of it in this Report, and, this permission having been kindly given, I am much gratified to be able to lay before my readers the following valuable detailed observation on serviceable and easy remedial application for this destructive attack:—

"*Insect Injury, 1890.*—A field of Yellow Globe Mangolds of 14 acres on the farm of Sir J. B. Lawes, at Rothamsted, was badly attacked by the Mangold Maggot (*Anthomyia betæ*).

"The field was manured with 20 tons per acre of farmyard dung, applied just previous to sowing the seed. The injury commenced in July, and gradually got worse until the leaves of the whole crop had the appearance of being scalded. They were of a brown colour and greatly shrivelled up.

"In the first week of August an application of 2 cwt. of nitrate of soda per acre was sown broadcast over the whole field. The injured leaves soon died off, and the plants formed new growth.

"The crop was taken up towards the end of October, and gave an average produce of almost 18 tons of roots to the acre."—(Communicated by J. J. Willis, with the permission of Sir J. B. Lawes.)

ORCHARD MOTH CATERPILLARS.

Winter Moth, Evesham Moth, *Cheimatobia brumata*, Linn.; March Moth, *Anisopteryx æscularia*, Schiff.; Common Vapourer Moth, *Orgyia antiqua*, Linn.; and other species.

Winter Moth; Evesham Moth. *Cheimatobia brumata*, Linn.

Winter Moth (*Cheimatobia brumata*): male, and wingless females.

The date of first attack of Winter Moth caterpillar in the past season might be put (so far as reported) as being about the end of March. At that time Winter Moth caterpillars were beginning work near Ross (Herefordshire), although they were not then noticeable at Toddington; and I had opportunity myself of seeing them hatching from collections of infested twigs and prunings placed in my hands for special observation.

By means of these specimens I was enabled carefully to study the changes of colour of the egg which occur during its advance to maturity, and also its form and size, and the external markings of the egg-pellicle; and afterwards, in the course of November, I had the further opportunity (from newly-laid specimens) of noting the colour when first deposited. As these points are all of practical use in determining what kind of infestation is present, I give some notes of the observations which I was enabled to make in detail.

On the 11th March I received, from Mr. Jesse Garrood, of Ledbury, cuttings of Apple twigs, which he mentioned he "had placed in a box in the autumn with a number of Winter Moths, male and female, the eggs deposited on the spurs being the eggs of the Winter Moth."

These twigs I placed in a box in my study, and on the morning of March 26th I found that many of the eggs had hatched. The empty shells were now mere iridescent films of whitish or bluish skin, almost glassy in brightness, and to the naked eye giving completely the appearance of the parts of the twigs on which they were placed being beset with little patches of bluish or greyish mould, or the down natural on some Apple twigs.

The eggs are bluntly oval in shape,—or perhaps might be better described as cylindrical, rounded at each end,—about a 32nd of an inch in length, that is, about one-quarter of an eighth of an inch long; the width about two-thirds of the length. Some of the eggs were still of the pale reddish tint of which they all appeared when sent to me, and a few were of a green tint—this apparently from being near development. The egg skin was pitted over the surface. With the help of a moderate magnifier it had the appearance of being shagreened. Under a one-inch power the markings showed as fairly regular circular depressions, so regular, in fact, as almost to give a honeycomb-like appearance.

The caterpillars were loopers, of a colour that might be described as dingy green or grey, and had black heads. They were perfectly active, moving characteristically in loops, or fixing themselves by their sucker feet and raising themselves erect, as if surveying the surroundings.

Taking now the development of the above eggs (which had been recorded by Mr. Jesse Garrood, of Ledbury, to be the eggs of the Winter Moth, deposited on Apple twigs placed in a box in which he himself had confined male and female Winter Moths in the autumn),—taking this as a guide, I proceeded to examine progress of eggs on trimmings from Pear trees sent to me, on March 12th, by Mr. C. Lee Campbell, of Glewstone Court, near Ross.

This was a very large collection, being the amount of trimmings or cuttings from ends of boughs taken by three men in three hours, in order to give me an idea of the great quantity of coming infestation, which might be removed by pruning in cases where the ends of the bough were in reach. The specimens, which were mostly in little bits, nearly filled a box about 15 in. long by 7 across, and 5 in. deep.

These eggs were somewhat differently placed to those on the Apple twigs. On the Apple twigs they were mostly on the shoots, though some were in the angle between the shoot and branch. On the Pear the eggs were mostly at the end of previously cut-back shoots, where the drying of the wood and swelling over it of the healing bark makes a protective depression. In either case eggs appeared to be deposited in the best shelter afforded.*

Some small part of the specimens sent me by Mr. Lee Campbell I kept in my study (in the same circumstances, that is, as those sent by Mr. Garrood), and at same date I found them hatching similarly. My eye was attracted by the little bright or whitish mould-like spots; and I found similarly empty egg-shells and greenish eggs, and some still reddish. The eggs had similar inequalities in the surface, and the little looper caterpillars were similar in appearance, and were already, though hardly the sixteenth of an inch in length, dispersing themselves about the inside of their box, and when disturbed were already able to spin a thread to attach themselves by.

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* Figures of the infested shoot (nat. size), also of cut-back shoot with the eggs deposited in a circle at the end (nat. size and magnified 5 diameters), will be found in the number of the 'Journal of Horticulture' for June 5th, 1890, p. 467.

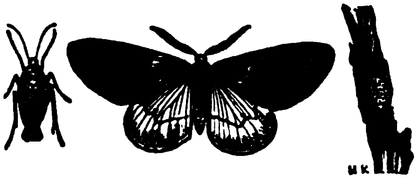
On the 28th of November I was favoured, by Mr. B. Danks, of Charlton House, Hartlebury, Kidderminster, with a tar-grease band on paper, about 2 ft. 8 in. long and 6 in. wide, as an example of the method in which the mixture used captured and held fast the moths. On this I found upwards of two hundred Winter Moths (male and female). In some cases the females had expelled a portion of their store of eggs, so that, where they were uninjured, the little knot of minute greenish bodies was very conspicuous on the dark sticky-banding mixture. The eggs were of a pale or watery green colour, pitted over the surface with hexagonal (or irregularly hexagonal) depressions; as nearly as I could count or estimate, there might be about twenty of these little pits or depressions in the length of the egg.

These markings were much more defined in the newly-laid eggs than in those in progress of development, so that the honeycomb-like markings which were irregular in the previously observed eggs showed very plainly in the recently expelled specimens. The colour also was of importance, as this, as well as the surface being punctured, agrees with the description given by Dr. E. L. Taschenberg of newly-deposited eggs of *C. brumata*. In the early spring observations we could only record them in the reddish tints which they gain in advance towards maturity, or in the various shades they assume just before hatching, from the tints of this very variously coloured larva showing through the transparent pellicle.

All the other points in the life-history of the Winter Moth which it is necessary to be acquainted with for practical purposes have, I believe, been brought forward so thoroughly in previous Reports that there is no need to enter on them again here, excepting, perhaps, to notice the continued confirmation given to previous observations of the wingless female being in some cases transported to the trees in connection with the winged male. Of this I have received direct record from observers during the past season, the pair being in one case captured after flight, and arrival in the tree, and preserved in confirmation of the statement. This habit is important to notice practically, and is the reason for our use of lanterns and sticky boards expressly to attract the winged male moths, whose presence otherwise would not require notice.

The March Moth was observed by Mr. C. Lee Campbell, of Glewstone Court, Ross, Herefordshire, as beginning to lay eggs about the middle of March. The specimen sent me on the 15th of March I found on the 18th had laid eggs, using the hairs from the pencil at the end of the tail (as is the custom with this moth) for a covering.

March Moth. *Anisopteryx æscularia*, Schiff.



March Moth; winged male, wingless female, and band of eggs.

This moth has been little, if at all, reported amongst the regularly recurring orchard pests, although it is a common kind, until last year (1889), when it was observed laying its bands of down-embedded eggs at the end of March (specimens sent me on the 29th) on Plum twigs at the Dimsdale Fruit Farm, Westerham, Kent. The caterpillars are "loopers," and of light or clouded green. If the caterpillar pests that appear in April were carefully examined, probably those of the March Moth would be found to be largely present amongst those commonly classed all together as those of Winter Moth, and their presence be found to be one amongst various reasons why even the most careful sticky-banding in autumn is not a perfect remedy for looper-attack. The female March Moths are distinguishable by being apparently quite wingless, with silky coats, brownish above, shading to grey below, and furnished with a dark pencil of hairs at the end of the tail, with which they cover their bands of eggs.

The only available means of prevention for this attack appear to be "sticky-banding" as for Winter Moths, but applied about the middle of March; also subsequently (about the end of March) looking for the rings of down-covered eggs at the end of small shoots or twigs, and cutting these off, *where in reach*, and destroying them. Also, as the chrysalids are considered to lie in their loose webs during winter, either *on* or in the ground, this is certainly a case in which stirring the surface during winter would be likely to do a great deal of good.*

The ordinary orchard moth attacks have been so fully and frequently entered on before that there is no occasion to repeat the observations. Amongst the most noticeable of them are damage from the brown and yellow "looper" caterpillars of the Mottled Umber Moth. Also from the gaily-striped orange, blue and black, somewhat large hairy caterpillars of the Lackey Moth, and the small greyish or white, or lead-colour (according to age or variety), spotted with black, of the "Small Ermine" or Small Apple Ermine Moths—these kinds being web-nest- or tent-making caterpillars. The large "blue-head" caterpillar of the Figure-of-8 Moth is another orchard pest, easily distinguishable by its large size, being about two inches long when full grown; by its greenish colour above, with a yellow stripe along the back and one on each side; by its yellow-green colour below; and by its black spots; also, frequently, from the bluish tint of its head, from which the caterpillar takes its name. Figures and descriptions of these have been given in previous Reports.

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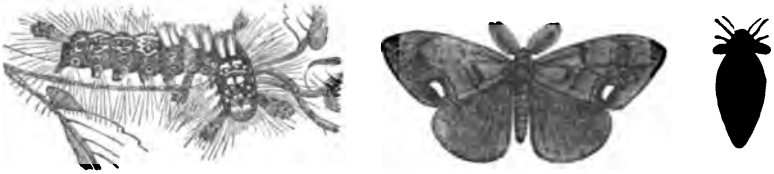
* For account at length of appearance and habits of March Moth, see 13th Report on Injurious Insects, by Ed.

There is, however, another kind of caterpillar, that of the Common Vapourer Moth, *Orgyia antiqua* scientifically, which has a capacity for doing excessive damage to leafage, but also (from the peculiarity of its habits) may be easily kept in check on moderate-sized trees. The male moth is of the size figured, the body and head brown, wings chestnut-brown, the fore wings patterned with darker bands, and with a white somewhat kidney-shaped mark on each. The female is grey, and almost wingless, and does not quit the immediate neighbourhood of the web-cocoon, from the chrysalis within which she has developed.



ORGYIA ANTIQUA.

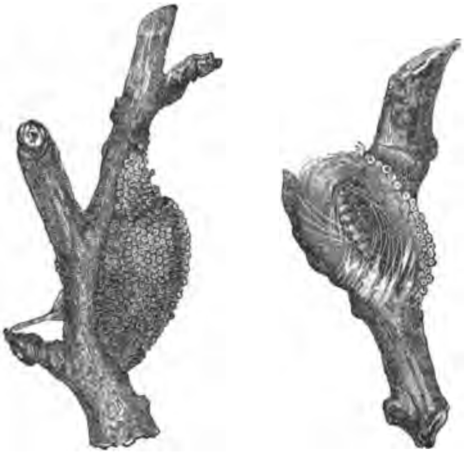
Caterpillar (after Taschenberg); male moth; female moth, with abortive wings.

The life-history is for the female when she comes out from the chrysalis to creep to the outside of the web-cocoon; their pairing takes place, and very soon after she begins to deposit her eggs on the cocoon, and near it, and dies. The accompanying figures, drawn from life, show the cocoon covered with eggs, and also a cocoon torn partly open to show the brownish or dusky yellow chrysalis lying within.

These fine caterpillars, which are stated to vary in length from about an inch and a quarter to two inches, when full grown, are dark grey, spotted with small red tubercles, and easily distinguishable by having four large tufts of yellowish or brownish hairs on the back, and also five pencils or bunches of long, dark, pin-headed hairs, disposed—one on each side behind the head, pointing forwards; one on each side of the fifth segment; and one on the back of the penultimate segment, forming a sort of tail-like appendage. By these characteristics the caterpillars are easily known from shortly after hatching. They appear to feed on almost all kinds of leafage, not only of orchard trees, but of Hawthorn, Sloe, and of Roses and other garden plants.

When full-fed, which may be from May to August, they spin their cocoons mixed with hairs on the twigs amongst the remains of the leaves on which they have been feeding, or on trunks of trees or palings, and in these the caterpillar changes to chrysalis, from which the moth appears in summer in about a fortnight. It is noticed by Edw. Newman, in his 'British Moths,' p. 40, that:—"The eggs do not hatch together like those of moths in general, but come out a few at a time over a period of ten weeks, so that the caterpillar, chrysalis, and moths are all found together throughout the summer and autumn."

In 1886 caterpillars were sent me on July 22nd from Linton-on-Ouse, with a report that two fruit trees had been stripped bare of leafage through the ravages of the caterpillars, and that they might be counted by thousands in all parts of the garden, and that this had been the case for four years, but that none of the neighbouring gardens were touched. In the same year I had a note of them as injuring Pear trees in another locality, and as having destroyed the leaves of most of the trees in that same locality in the previous summer.



Cocoons of *O. antiqua*, respectively covered with eggs, and showing chrysalis within.

Excepting, however, these observations, I am not aware of any notes of its presence having been sent until the past season, in which I had an observation in the early part of July of the caterpillars doing great damage to Plum (especially to Victoria and Greengage) in an orchard house in some well-known nurseries in the South of Ireland, where it was noted as being "most destructive if neglected."

The real trouble from its presence, however, is where it gets hold in regular orchard growths, and relatively to this point I was favoured in November last with excellent specimens of the egg-covered web-cocoons, and also an opened web showing the chrysalis skin still remaining within, which were sent to me from Croome Court, Severn Stoke, Worcestershire, by direction of the Earl of Coventry.

By kind permission of Lord Coventry I give the above figures of two of these specimens, and the short note of observation following:—

"My bailiff yesterday, in looking round the trees, detected amongst the branches eggs on a web, and the deposits which he supposes are also eggs." My attention was also directed to the remains inside the cocoon, which proved to be the chrysalis.

Examination of the figure will show the great number of eggs quite coating over the outside of the cocoon, and consequently show that the starting point of what would be much future mischief if neglected, may be very easily got rid of where the egg-covered cocoons are in reach. These should be carefully looked for, cut off, and destroyed wherever infestation is found to be present. When the twigs are out of reach of common measures, the use of a pair of very small, sharp hawks'-bill nippers, placed at the end of long-handled shears, would be desirable.

So far as I am aware, this kind of implement is not nearly as much used as it should be. I have myself found a form with light handles about five feet long extremely convenient, and by means of a light hand-cart, which could be easily wheeled from tree to tree, a moveable platform would be available by which the operator could reach to a very fair height. A plank laid across the little cart from side to side would give firm standing position, and a means of reaching up to egg-laden twigs of many kinds,—notably of Winter Moth and Mottled Umber, and the egg-bands of the Lackey and Vapourer,—and (generally) give, with moderate convenience and little expense, a means of carrying clearance of pest presence about five feet higher than is often the case.

PREVENTION AND REMEDIES. — The careful series of observations which, either in experiment or regular practice or report of results, have been continued from February last up to this present date of December, 1890, show that the two main points to rest on for prevention and remedy of loss from attacks of orchard moth caterpillars generally are—"sticky-banding," to stop the ascent of the wingless moths; and spraying, to destroy the hordes of moth caterpillars of any, and all, of the various kinds which ravage together on the leafage in spring.

The reader will please observe that here we are only speaking of MOTH CATERPILLARS, not of Aphides or Green Fly, nor of Beetles, nor of Scale or other kinds of insects, which, being in some cases stationary, in some reaching their position by flight, and in some gaining their sustenance by driving their suckers into the soft tissues from which they draw the juices,—thus are not captured by "sticky-bands," as they have no occasion to cross them; nor are they destroyed by poisonous spraying on the leafage, for their suckers go down beyond the excessively slight superficial coating which alone is to be recommended for special use.

With regard to sticky-banding.—The great points are to use a grease or preparation which will continue sticky, but not be moist enough to run down, and also (and this point is of *vital importance*) so to apply it as not to injure the bark and underlying tissues of the tree. The safest plan is to band on strips of common strong grease-proof paper. This can easily be procured at a small cost, and cut in strips of about seven inches wide, or of whatever width may be wished. The length may vary or not with the size of the tree, for there is no harm in the ends of the strip overlying each other. The method of application is for the strip to be placed round the tree, and fixed firmly either by being tied securely with string passed round near the upper and also the lower edge, or by running a band of paste beneath the overlapping end of the paper, and thus keeping it fixed safely down on the rest of the paper. On this strip the grease may be painted, or it may be smeared on with a smooth bit of wood like a paper knife, and thus all or much of the risk of grease soaking into the bark be avoided.

How far yearly application, even of good grease, may affect tender bark and underlying tissues, is a point which can only be known by examination, and which it would be well to have further notes of. In a letter to myself Mr. J. Masters mentioned the difficulty of getting pure grease, and that, if not good, sooner or later it would be found to affect the trees. "Some of the fruit stems I have felled, in cleaving them up, show distinctly, as compared with the other parts of the tree, how the grease has penetrated the inner coatings of the bark."—(J. M.) I should fear that this would be the case oftener than is supposed, even with good grease.—Ed.

Tar should *never* be applied to the bark. The late Capt. Corbett, Manager of the Toddington Fruit Grounds, wrote me:—"Please note I have discarded tar, for I have found instances where even when mixed with grease it has on drying formed a tight band round the bark and destroyed the tree."

Mr. C. D. Wise also wrote from Toddington:—"Where tar has been used I have found the tree alive up to the place where the band was put on, but above the band dead."

Judging from a specimen of tar-grease banding now before me, I should say that even for use on grease-proof paper an admixture of tar is not safe. The mixture has been very successful in catching the male and female moths, but at the date of examination (Dec. 10th), that is, a few days after it was sent me, I find that the back of the long strip of "grease-proof" paper is of a deep brown from the tar, or tar and grease together, having soddened through from the front. The extent of the mischief in a case like this would be nothing to compare with that of tar banding on the bark itself, because, amongst other reasons, the application itself is not left to form a crust on the bark, gradually melting into it with warm sunshine; but still, considering the variety in the composition of mixtures used for grease, or sticky-banding, it would be as well to be sure that the kind of grease-proof paper used would not allow them to penetrate to the bark.

The mixtures sold under the name of cart or waggon grease, or as axle grease or railway grease, differ exceedingly in the ingredients used, and in some cases might be exceedingly hurtful. The simplest form for what is sold as cart grease appears to be a mixture of tallow, palm oil, and soft-soap. Another mixture is of a more or less perfectly formed soap, water, carbonate of soda, and neutral fat. Another is a soap of lime and rosin oil, with or without water; and a mixture similar to this last or much resembling it was found to answer well at Toddington. A grease with tar oils mixed with sulphate of lime and water burnt the bark, and this is just an instance of where grease-proof paper would need testing. If it resisted the penetration the additional deterrent powers of the tar oils would be an advantage, but if *not*, these being even to a lessened extent allowed to come in contact with young live bark would do a deal of mischief. The kinds of "axle grease" or "lubricants" containing petroleum or petroleum residue would also be very injurious.*

Prevention by greased hay ropes laid on the ground so as to encircle the guarded tree.

The following communication with which I was favoured on Nov. 20th by Mr. Arkwright, of Hampton Court, Leominster, is well worth notice:—"I visited my orchards which have been treated with cart grease three weeks ago, and found the hay bands in perfect order and catching every living creeper. The grease had not melted or hardened, and I am perfectly certain that no crawling creature could pass the band.

"I twisted hay round a piece of cocoa-nut string such as they use for Hops, and tied it as tight as I could round the trees; afterwards painting the under angle of outside with the common grease bought in tins for cart wheels. Common cart grease bought in 14 lb. tins at Ballow & Co., Leominster. It comes to about 2d. a pound."—(J. H. A.)

With this communication, Mr. Arkwright was good enough to send a hay band for examination which appeared to be answering its purpose very thoroughly. The grease was still quite soft and tenacious, and the method of applying it mentioned by Mr. Arkwright meets (so far as I can see) the practical objection to the use of tar or grease hay-banding on the ground, namely, that the moths harboured under the edge.

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* For more special notes on these see pp. 59 and 60 of my '13th Report on Injurious Insects,' where are also references to recipes in a paper on lubricants in 'Workshop Recipes,' by C. Warneford Locke, published by E. & F. N. Spon, Charing Cross, London.

In the case of the sample sent me, the sodden greasy mass seemed very deterrent to any such harbourage, and the plan altogether to be a cheap convenient form of banding, well worth drawing attention to. If further tried I should be glad of any reports regarding it, as if generally successful the simple method, only needing some hay and string and common cart-grease, would often be used where measures requiring more purchase of material, and more care in applying, would not be carried out.

Time of appearance of the moths.—The variableness of date of appearance in different localities, or in one locality under different circumstances is a troublesome point practically. In the past autumn, Mr. Wise wrote me, from Toddington (near Gloucester), that the first female Winter Moth was caught on the 17th of October, one day earlier than last year. Mr. Hiam writing from Astwood Bank, near Redditch, at the date of Nov. 8th, mentioned that the Winter Moths were then being taken in quantities in the grease bands, and that the first appearance had been observed a fortnight before.

At Glewstone Court, Ross, Herefordshire, Mr. C. Lee Campbell, writing on the 4th Dec., mentioned, "The Winter Moth put in its appearance here at last, a month later than last year;" and at Croome Court, Severn Stoke, Worcestershire, in observations with which I was favoured by Lord Coventry, it was noticed (a little prior to the 22nd of Nov.) that "the greasing was commenced about a fortnight ago, but at present no results have been observed." On the 22nd a report was sent that "the wingless moths are now ascending the trees, and are being caught in the grease bands in large numbers," and also that many winged moths were caught in the smear.

The foregoing observations, taken at places no great distance from each other, give a range of somewhere about a month in difference in date of first appearance, and there does not appear to be any way of meeting this difficulty practically, excepting by having examinations carefully kept up by an observer going with a lanthorn for successive evenings after sunset, or till towards 10 o'clock, to see whether the moths are ascending. Or if this plan is too troublesome, beginning as soon as ever moth presence may be expected, and having a few trees grease-banded and examined daily as to amount of capture. The matter of coincidence of date in first greasing, and first appearance of moths, is of a good deal of importance, or on one hand there will be a waste on the drying grease, or on the other a chance of the ascent of the moths preceding the application of the sticky-banding.

Paris-green.—Up to the present year, sticky-banding has appeared to be the only reliable measure for us to depend on in this country, in order to stop the ascent of Winter Moths, or other wingless kinds of moths, which creep up the stems of orchard trees to lay their eggs on the branches. But, at the same time, it has become more and more plain each year that although sticky-banding is so far of service, that in many cases the foliage of orchard trees would have been totally destroyed if the banding had not been done, yet still that it is only a partial protection against *wingless* moths gaining access to the trees for egg-laying, and is no protection at all from the many kinds of attack originated by *winged* infestations: also it is expensive, needs renewing at intervals, and, without special arrangements to insure safety to bark, is detrimental to the health of the trees.

Some kind of application was greatly needed which was cheap and sure in its action, and which could be brought to bear at once when required on any or all sorts of moth caterpillars together (whatever their various natures or previous histories may have been), and would kill the whole collection of ravaging hordes at once, but without damaging the leafage.

For some years back trials have been made, in many isolated cases, of various kinds of treatment which it was hoped *might* lessen the hordes of caterpillars which now yearly cause great injury to leafage of our orchards; but as these experiments were seldom carefully recorded as to details or results, they have been of little public benefit.

It therefore seemed desirable to form a regular Experimental Committee, of members cognisant of all the needs of the case, and also *known to be qualified*, both practically and scientifically, to superintend experiments in orchard treatment, and report results.

Accordingly, about the end of February in this year, 1890, at a conference of fruit growers held at Evesham, a Committee of Experiment was formed, of gentlemen personally interested in the subject, as land owners or fruit growers on a large scale, or superintendents of large fruit grounds, or in other ways much concerned in the preservation of orchard crops.*

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* The Committee consisted of Mr. Gibbon, of Seaford Grange, Pershore (who has given valuable aid to the Committee as Chairman); Mr. J. Masters, of Evesham, Hon. Sec.; Capt. Corbett and Mr. C. D. Wise (respectively Superintendent and Deputy-Superintendent at the great Toddington Fruit Grounds); Mr. Swift, a large land owner and occupier of land in the neighbourhood; Mr. Doeg, of Evesham; and Mr. Hiam, of Astwood Bank; likewise Mr. F. Hooper and Mr. E. Grove. I rendered what assistance lay in my power as the Consulting Entomologist of the Committee, and we were greatly favoured by being allowed in all difficulties to apply for advice to Mr. J. Fletcher, the Entomologist of the Dominion of Canada; and thus knew that so far as we followed instructions we were trying no new thing, but what had been known to answer in Canada and America for regular orchard service for years back.

The plan of operation was for the members to try the effect of any kind of sprays, washes, or other applications which they might judge likely to be effective in destroying the caterpillars on orchard trees without injuring the leafage; and to meet at various different centres from time to time, so that the whole Committee could judge of results of various treatments, and consultation and detailed reports of the method of treatment take place, or be given by the members. Also, as it was before us all, in reports of the Agricultural Departments and State Entomologists of Canada and the United States, that for years back attacks to orchard trees, perfectly similar in their nature to those which have been causing us such loss here, were lessened or wholly prevented there by applications of spraying with the chemical known as Paris- or Emerald-green, of which we had full working details,—one especial part of the work of the Committee of Experiment was to test the serviceableness of this especial application in our rather different climate, and with (at that time) our inferior apparatus for throwing fluid.

This plan was thoroughly carried out, and amongst the special consultations may be mentioned the meeting at the Toddington Fruit Grounds on the 1st of May; also at Seaford Grange, the residence of the Chairman of the Committee, on the 14th of the same month; and on the 11th of June, to inspect the plantations of Messrs. Masters & Groves at Greenhill. At these meetings the several experiences of the members were given, showing clearly that, even under careful experiment, just the same uncertainty occurred, with regard to good effects of *almost* all the applications, as has appeared to be the case for years back. Alum, hellebore, chrysoline, ammoniacal liquor, &c., were reported on, and sometimes found useful; sometimes, as in the case of alum, found occasionally useful, but also, and on very careful trial elsewhere, of not the slightest service; and later on, when the caterpillar was more advanced, the alum was found to be of no service at all.

Full reports of the information given by the members and the discussions thereon, likewise their reports of the condition of the trees experimented on, were given at the time in the local journals, so as to be preserved in detail and accessible for reference; * but the results embodied in the recommendation of the Experimental Committee, given after their consultation on May 3rd at the Toddington Fruit Grounds, may, so far as "Paris-green" is concerned, be rested on as confirmed by repeated trial subsequently, and the good results shown by the autumn returns of fruit in such cases as I have report of.

The Committee, in reply to the statement that "many people were waiting to give the mixtures recommended a trial," decided that they could recommend the following :—Paris-green paste in the proportion of 1 oz. to 8 or 10 gallons of water for Plums, and 1 oz. to 20 gallons of water for Apples ;* London-fluid, one part to twenty parts of water. † Both these they recommend as effective in destroying the caterpillar, while they did no material harm to the leafage.

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* See especially 'Evesham Journal' and 'Evesham Standard,' of dates of Saturdays immediately following days of meeting, named above.

The proportion above mentioned should not be exceeded. Capt. Corbett, in finishing his report of the Toddington experiments at the above meeting, mentioned that, "With regard to Apples, it seemed to them that the foliage was much more tender than that of Plum trees, and they thought that one ounce of Paris-green to twenty gallons of water was the proper preparation for them" (*i. e.*, for Apples, Ed.). "He wished to be very guarded about the blossom. He was only speaking of the foliage. The Pears should be treated as the Apples were." Mr. Masters added to the observations, on the part of the Committee, that they considered the syringing should be done when the leaf bud was first developed, before the blossoming period, and then again after the blossoms had disappeared and the fruit was forming.

The following note, sent me by Mr. Wise from Toddington, in order that I might be able to report results of our work to the Seeds and Plants Diseases Committee of the Royal Agricultural Society of England, on the 3rd of June, confirms the previous observations :— "We have, as you know, tried all sorts of mixtures, and I do not think it is worth while troubling you with all particulars of them, as they were all useless, or nearly so. Paris-green is the only thing which we have found really efficacious. For Plums the proportion is 1 oz. to 10 gallons, and for Apples 1 oz. to 20 gallons. We have also used the former strength for Currants, but as the foliage is within the last few days becoming so much stronger, we have been using it at 1 oz. to 8 gallons. Neither of these solutions has damaged the foliage, but killed the caterpillar."—(C. D. W.)‡

The following remarks, sent early in the year by Mr. Fletcher, Dominion Entomologist of Canada, who assisted us greatly by his skilled as well as practical advice, are well worth notice:—"Begin with too weak mixtures rather than too strong. Weak mixtures, although slower, are yet quite sure in their work. In your damp climate, too, it *might* be the case that the effects on foliage might be more injurious than in our dry air."—(J. F.)

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* "Paris-green paste." Arrangements have been made by which the Paris-green powder may be furnished in a slightly damped condition, so as to do away with all danger of the dust being inhaled in mixing.

† "London-fluid." This is a fluid form of the arsenical preparation known as "London-purple," prepared by Messrs. Hemingway, London, who liberally presented a large supply for experiment. It is preferred by some orchardists to the Paris-green, and, as will be seen in the following notes, was used with success in some instances. But the experiments of the Committee pointed to the Paris-green as being more reliable.

‡ Notes with regard to un-desirableness of spraying on the blossom, also as to serviceable kinds of engines, or apparatus for delivery of the spray, and other necessary details, will be found under their respective headings.

It is somewhat curious that whilst in Canada, as observed by Mr. Fletcher in a part of the letter quoted above, "Paris-green is more injurious to Plums than to Apples," here the reverse, so far as we see at present, is the case. The proportion used for Apples is only half the strength of that which may safely be applied to Plums.—Ed.

The following note of operations, sent on June 28th by Mr. John Riley, of Putley Court, Ledbury, is very well worth reading relatively to all the points entered on; notably success in destroying moth caterpillars by use of Paris-green, and without damage to foliage. Also *non*-success in killing Aphides with this application, and *success* in use of *soft-soap* and quassia. I should like particularly to draw attention to this. It is not generally enough considered that Aphides feed by suction. They thrust their suckers down into the soft tissues on the juices of which they feed, and consequently are by no means certain to be hurt by poisonous matters lying *on the surface* of these leaves or shoots. The soft-soap adheres to them, and so chokes up their breathing-pores, and if anything can be added to the soft-soap which will injure these Aphides or Green Fly by being absorbed into them, it will be so much the better; but Paris-green will not kill them (as it does the caterpillars) by means of their eating the poisoned surface:—

"We tried Paris-green, London-purple, and chrysoline for the caterpillars. We began late, when the caterpillar was strong. Paris-green we found by far the best; it killed nearly all the caterpillars in a short time, and did not damage the foliage at all. It was used as recommended by your Committee. We afterwards tried it for Aphis, which was doing great damage to Plum trees and Damsons, at 1 lb. to 100 gallons; this did not injure the foliage at all, but the Aphis did not in the least mind the application, and I have since had to wash with soft-soap and quassia, which was quite effectual. London-purple injured the foliage a little, and was not nearly as effective as Paris-green used as recommended. Chrysoline was also not so effective as Paris-green. In the Grass orchards I used alum, from 2 to 3½ oz. to the gallon—caterpillars strong; I think it rather checked them, but it did not kill many. I doubt if I saved much fruit by it, but perhaps the leaves were not so completely destroyed as they otherwise would have been. I had a jug of about 2 quarts with 4 ozs. of alum in, well mixed, and I bent down a sprig of Plum covered with Aphis into the solution, and the foliage was not injured, and the Aphis quite uninjured too."—(John Riley.)

The following observations, sent by Messrs. Salmon, of Sutton Farm, near Hounslow, show beneficial effects of applications of Paris-green, even without any more special appliances for distributing the spray than our ordinary garden engines. On the 17th of April Messrs. Salmon first wrote to me mentioning that they were greatly troubled with the blight, and had tried sulphate of copper on some of their young trees, but were afraid of injuring the buds.

In reply to the enquiries sent, I suggested trial of Paris-green, and six days later (on the 23rd of April) Messrs. Salmon wrote me:—"We are using Paris-green, and find it very effectual; we have two men on continually with garden engine."

At the end of May, being desirous to learn results, I wrote to Messrs. Salmon, and received the following very satisfactory reply:—"All we can say to it is to its advantage. It has succeeded admirably. The trees look healthier and better, with as much fruit (if not more) on as anywhere else; they are beautifully clean. It has not injured the foliage in the slightest. We shall always use it in case of blight."

The following is a short summary of results, and consideration of the position of our experimental work up to date, which was sent me by Capt. R. J. Corbett on the 3rd of July from Toddington:—"I have lately returned from France, and have been anxious to see the result of the experiments in spraying. First, I will say that the proportions I fixed upon after the first trials, *viz.*, 1 oz. to 10 gallons of water for Plums, and 1 oz. to 20 gallons of water for Apples, must not be exceeded. Even with these proportions I think the end of the leaves in some cases have been scorched. Our crop of Plums is the best we can hear of, though much loss has come from the Green Fly. I think that this pest" (caterpillar pest, Ed.) "can, and ought to be, kept under control, and that a more persistent course of spraying would have done so. Do you not think it would? It seems to me that we have made a good beginning this year, and that next year we shall, by reason of experience gained, do a great deal better—in fact, I believe we can now keep the enemy under."—(R. J. C.)

In some cases a rather stronger proportion of Paris-green than that named was used safely, and in the course of June, Mr. Masters, of Evesham, favoured me with the following note regarding mixture of flour with the green:—"When the foliage of trees is young and tender, I do not think it safe to apply the Paris-green stronger than in the proportion of 1 oz. to 10 gallons of water. But when the foliage is matured, and the caterpillar is full-grown, a solution of 1 oz. Paris-green to 6 gallons of water may be safely used; for every case it would be well to use about 2 lbs. of fine wheat flour to every pound of Paris-green; it thickens the solution, and prevents the particles of Paris-green from settling at the bottom of the vessel, and, when it is sprayed, helps to secrete the preparation on the foliage."*

There is, however, so very much fear in first experiments of too strong a mixture being given that, though with care a larger proportion of "green" *may* serviceably be used, as will be seen in the following extract, the Committee did not undertake to *recommend* a stronger application:—

For liquid application.—The amount recommended for spraying for Codlin Moth or young "looper" caterpillar is "not more than from 2 to 4 ozs. in 40 (forty) gallons of water, or ⅛ to ¼ oz. in a pail of water (4 gallons, E. A. O.), to be applied as a fine spray by means of a force-pump. The foliage must not be drenched, but the spray should only be allowed to fall upon the trees until it begins to drop from the leaves."

"*For general use on mature foliage.*—½ lb. of Paris-green, 50 gallons of water. First mix the Paris-green separately with a small quantity of water, then add to it the whole supply. All washes containing Paris-green must be constantly stirred to keep it in suspension, or it will sink to the bottom."†

On these points Mr. Fletcher, the Dominion Entomologist of Canada, who greatly assisted us by his valuable advice, wrote to me enforcing care as to over-application:—

"*Paris-green.*—You are quite safe in recommending this; but insist upon these two things, *viz.*, 1st, to keep the mixture (which is a mixture, not a solution) well stirred all the time, and have the barrel well washed out after it has been filled ten or twelve times. The Paris-green is very heavy, and will keep sinking to the bottom unless constantly agitated, and as the barrel is frequently re-filled the residue will keep accumulating, until it will be too strong as the mixture reaches the bottom.

"2ndly. The other point is to insist upon the mixture not being made too strong; 1 lb. to 200 gallons I find very useful, and I never use stronger than 1 lb. to 120 gallons."—(J. F.)

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* The above observation by Mr. Masters is the only notice received of trial of mixture of flour with the "green." This practice, however, is highly recommended by Prof. C. V. Riley, Entomologist of the Department of Agriculture, U.S.A. In his 'Bulletin No. 3 of the United States Entomological Commission,' Washington, 1880, at p. 57 he mentions in observations on use of Paris-green in liquid suspension:—"It pays to add two or three pounds of flour or starch to the mixture, not only from the greater adhesiveness which they give to the poison (a very desirable object, especially in wet weather), but because by their colour they help to indicate the quantity that has been distributed. In using flour it will be found advisable to mix it first in a bucketful of water, and allow it to remain until it sours, the object being to prevent it from forming lumps." If any further experiment should be made with this admixture, I should be glad of notes as to whether the flour is in any way injurious by choking up the pores, or too thickly covering the leaves.—Ed.

† 'Report of Entomologist, Central Experimental Farm, Department of Agriculture, Canada,' 1887, p. 21.

With regard to method of application of the spray.—This should be thrown so finely as to reach all parts of the tree, and both sides of the leaves, and coat the leaves as with a fine dew, but it should *not* be allowed to run down and drip. As soon as dripping begins spraying should cease.

It should not be done whilst the trees are in blossom, and warning is also given in the American works that sprayings should not be given in rapid succession. Several days, it is advised, should elapse between, unless of course, as may easily happen in difficulties of first experiments, the spray was manifestly so weak that the application counted for nothing. The effect of the Paris-green on the caterpillars does not always show directly, and it is undesirable to waste labour and material where the work is already done, and only requires a day or two to show it.

Our work was much held back at first in many ways, as all new introductions commonly are; partly by objections, some founded, some unfounded (chiefly the latter), and especially from writers who appeared totally unacquainted with the fact that the *reason of our* work was that the applications *they advocated* had been tried for years, and proved *useless*; partly also, and very greatly, we were held back by want of proper apparatus. As pointed out by Mr. Masters at the Committee-meeting at Evesham in October:—"In this emergency resort was made to ordinary syringes, garden engines, or any apparatus at hand to spray the foliage of the trees." . . . . "If a Strawsonizer could have been used, it is probable that one pint of poisoned liquid diffused in its misty particles would have been an ample supply to bedew and poison every leaf in the largest tree." . . . . "Added to this is the irregularity of spraying, some of the boughs having a copious sousing, and some but very little."

These remarks of Mr. Masters', of which I regret that space only allows me to give a portion, are well worthy of notice, and I should like to direct the attention of my readers to the very practical lesson which may further be drawn from a little calculation based on these observations.

It is the very essence of our spraying work that *no "drip"* should take place, the spray should fall (or rise) as a haze and remain as dew, and 1 oz. of Paris-green to 10 gallons of water is the highest strength we recommend. This gives one-tenth of an ounce to one gallon of water, which would be a proportion of one-twentieth of an ounce to half a gallon, or two quarts, and half of this again would be the fortieth part of an ounce to one quart of water. Therefore, supposing instead of the pint of water (the amount named by Mr. Masters) dispersed as it should be (and quite easily could be by the Strawsonizer) in misty dew on the leaves, we give twice the quantity, that is, a quart, we only distribute *one-fortieth of an ounce* of the Paris-green, of which, according to the percentage analysis, only about a third (32·11) is arsenic.

I think the above calculation is worth notice as a key at least to understanding the foundation and essence of success of our work, and also in order to be able to put it before those who endeavour to throw difficulties in the way of preserving our fruit crops by erroneous statements.

We do not work by washing the trees down with unlimited amounts of poison dropping from the leafage; if we did, it would serve no purpose. What is sent in fine film is intended to remain merely as a light dew on the leaves.

To recapitulate: taking, as I noted above, double the amount of spray estimated by Mr. Masters to be needed, this shows (to put it in plain words) the amount of arsenic deposited in film on the whole of the leafage of a large tree to be only *rather* less than the third of a fortieth part of an ounce—this on Plum, half that amount on Apple and Pear.

Non-feeding of animals under sprayed trees.—As, however, it is totally impossible to guard against what may be done by careless workers, or those who will not take the trouble to understand what they are about, in all *we* (that is to say, the Experimental Committee as a body and myself personally) are desired to advise on, we most scrupulously direct that *cattle and stock and other animals should never be allowed to pasture or feed under trees that are being, or have recently been, sprayed*, for fear of injury from feeding on Grass on which there may have been drip. We give no opening for possibility of mischief occurring from this cause where our advice is followed; but (having noted this duly) there is no harm in mentioning here that where the fine spraying is properly carried on, it is at least open to doubt whether any risk in the above way is incurred.

In the course of reporting, it appeared that one observer fed his mares and foals beneath the Paris-greened trees with no ill effects. Mr. Lee Campbell, of Glewstone Court, Ross, also alluding to this point, wrote me:—"You will recollect that I sprayed the trees this year ten times with Paris-green, partly 2 ozs. to the 20 gallons, and later with only one, and during the caterpillar season (in fact, all the year until the fruit was becoming ripe) fowls have had a free run all over the field."

I have also received a report to a similar effect from Messrs. Salmon, of Sutton, near Hounslow, who were very successful in the use of Paris-green, relatively to small birds. They informed me that they had neither found dead birds nor seen any signs of harm caused by the application in their sprayed orchard grounds.

With regard to Bees, as the trees should *not be sprayed when they are in blossom*, this gets over any fear of Bees being poisoned. But until the use and methods of application of Paris-green are thoroughly understood, we must still give the caution, whether needed or not, never to pasture or feed stock, poultry, or any other animals beneath trees which are being, or have recently been, sprayed with Paris-green.

Further on I give notes as to the nature of Paris- or Emerald-green, and cautions as to the points that need to be attended to in its use; also notes of appliances for its proper distribution; but (in order to give the observations in some sort of continuity) I add from those received two of the most notable from known observers of our success in saving the fruit crops, with observations of the satisfactory diminution of Winter Moth presence, found at sticky-banding time in autumn, where our treatment had been carefully carried out.

Report of Plum crop at Toddington.—On September 4th, Mr. Wise gave the following satisfactory report, from the Toddington Fruit Grounds, of the condition of the Plum crop:—"I am making preparations for commencing the operation of grease-banding on October 1st. You will be pleased to hear that we have a grand crop of Plums, and I attribute this entirely to our exertions in keeping down caterpillars. No one else in the country appears to have many, and we are making fabulous prices."

It must be borne in mind (independently of the especial considerations which are the subject of this paper) that the large output of 510 tons of out-door fruit, which has been harvested at Toddington this season, and which has been noticed in so many of the newspapers, has, of course, to be counter-balanced by the large amount of expenditure incurred; and that, whilst fruit-farming will certainly pay those who can patiently wait, still it is a matter which must not in any way be looked upon as a profitable venture without a good deal of uncertainty in the early years of its formation.

But the greater the outlay on this importantly increasing branch of British farm industry, the greater is also the need to have at hand the best means of preventing the results of the outlay being as rapidly and fully swept from the trees as if a devastation of locusts had taken possession; and I think I can do no wrong in adding that, in almost the latest letter which I received from Captain Corbett, the Superintendent of the Toddington Fruit Grounds, shortly before his much-to-be-regretted decease, he spoke in the strongest terms of the benefit received in saving the fruit crops by means of the spraying treatment, on which we had been so carefully experimenting.

Mr. Masters, of Evesham, also, as noted in the following observations, sent on the same date as the above, benefited greatly by his careful treatment of his trees:—"We are very busy finishing the fruit-picking. I am pleased to say I have been fortunate this season, having had a considerable crop of Plums, and which have been selling at high prices. My neighbours are now, from my success, beginning to realise the importance of taking proper precautions."

Diminution of amount of appearance of Winter Moth in the past autumn.—Mr. J. Masters, writing from Evesham, on the 30th October, remarked:—"The point you especially refer to of the diminution of the pest, I find already is the case. Some of my plantations that were some years ago so badly infested are now so free from the Winter Moth that even last year, notwithstanding our grease-banding, we could scarcely capture one single moth; and here we were rewarded with heavy crops of Plums this season."

The following observations, sent me a few days after (on the 5th of November) from Toddington, by Mr. C. D. Wise, give a most satisfactory account of the gradual lessening (where preventive measures have been taken) of amount of Winter Moths captured on the grease-bands, of the great diminution in the number as then compared to what the number was three years ago, and also the very noticeable fact that in a plantation which had been syringed, with the exception of one acre, with Paris-green, that on this one acre more Winter Moths were captured than anywhere else. Mr. Wise wrote:—

"You will be interested to hear that we caught the first female Winter Moth on the 17th October, one day earlier than last year; also that we are catching very few this season, the greatest number I have seen on a tree being nine. This is a vast difference to three years ago, when we counted as many as 500 on one tree, and I think it shows that all our trouble has not been in vain.

"You will remember that I reported to you last year that the number of moths caught greatly decreased in number as compared with the former year; now this year, as we are catching so very few, I think it is most satisfactory.

"You will be interested to hear that in one plantation where we syringed with Paris-green, and where the men in doing so emptied their buckets before they got to the end of the row, and left about one acre unsyringed; on this one acre we have caught more Winter Moths than we have anywhere, and this shows conclusively what the syringing did for us.

"I really think next year we shall be able to use narrower bands on the trees. This will save paper and grease."—C. D. W.

Rather later on—the 19th of November—Mr. Wise further reported, "We are still catching very few moths."

On Nov. 20th, Mr. J. Hiam, of Astwood Bank, Redditch, who has bestowed much attention on the subject of caterpillar prevention, and who, as well as the two above-named gentlemen, is a member of the Evesham Fruit Conference Experimental Committee, wrote me that he "found a wonderful difference in the quantity of moths caught on the grease bands on trees syringed with Paris-green in the summer, or rather in late spring, and those not syringed. Trees growing side by side have hundreds of moths caught in the one case, and comparatively none on trees dressed."

I gladly accepted Mr. Hiam's offer to furnish me with precise details of treatment and results, as these records are just what are of so much value to possess and so difficult to procure. Therefore I give Mr. Hiam's Report, sent me on Nov. 22nd, verbatim as follows:—

"The following brief remarks are respecting the results of my experiments with London-purple and Paris-green, in connection with the Evesham Experimental Committee on Fruit Pests."—J. H.

"No. 1.—London-purple fluid, applied to an Apple tree early in April before the buds had opened, and when the caterpillars of the Winter Moth were hatching out. Strength, 20 parts of water to 1 of London-purple, applied with a fine nozzle syringe. Second application after bloom had set.

"*Results.*—A fine crop of very clean nice fruit.

"Band of grease dressing applied to tree stem on waterproof paper early in October: not a moth caught, neither male or female, although the band is in excellent condition.

"No. 2.—Apple tree syringed with Paris-green before the buds expanded, and again after the fruit had formed. Strength, 1 oz. to 10 gallons of water.

"*Excellent results.*—Tree laden very heavily with medium-sized fruit.

"Grease band has caught one female moth and four males.

"No. 3.—Standard orchard Apple tree, 20 in. circumference, syringed with Paris-green after (but not before) blooming.

"*Results.*—Very little fruit.

"Caught on grease band three females and fourteen male moths.

"No. 4.—Standard orchard Apple tree, 36 in. circumference. Syringed with Paris-green too late to save the bloom.

"Caught on grease band three females and twenty-one males.

"No. 5.—21 in. circumference. Syringed with Paris-green somewhat earlier than No. 6" [precise date omitted, Ed.], "but probably by about the end of April: this is *too late* for the first application for some kinds of Apples. It bore some fruit.

"Four females, twenty-two males.

"No. 6.—30 in. circumference. Was syringed with Paris-green about the end of May, when it was apparent that the caterpillars were fast clearing it. It had only one dressing, and the foliage which appeared afterwards was free from caterpillars, showing that the application was satisfactory.

"Six females, eight males.

"No. 7.—*Not* Syringed with any insecticide, 57 inches circumference. One hundred and thirty-eight females, one hundred and three males. Bore *two Apples* only.

"No. 8.—*Not* syringed with any insecticide, 84 inches circumference. Eighty-two females, eighty-five males. Bore about half a peck of Apples.

"No. 9.—Tree partly syringed with London-purple, early before buds expanded. The portion of the tree syringed bore a nice crop of Apples of good quality; foliage good.

"The portion of the tree not syringed bore very little fruit, and the foliage was very badly damaged.

"Grease bands; about two-thirds of the trunk banded with water-proof paper, on twenty-seven inches of the circumference, eighty-five females, fifty-three males.

"Nine inches of the bark was dressed direct (without any paper), on which two females and two males only were caught, thus showing the effect of absorption of the sticky part of the dressing by the bark."—(J. H.)

To the above report Mr. Hiam added the following summary:—

"Six trees syringed, on which were placed 128 in. of bands. Moths caught, females 17, males 69.

"Three trees, two of which were unsyringed, and one partly so. 118 in. of band. Females caught 305, males 241."

Looking at the season's work as a whole, also from the well qualified opinion given by Capt. Corbett on the careful trials at Toddington, and opinions sent me in reply to my successive reports, by the Dominion Entomologist of Canada, I consider it cannot be looked on as other than a *success*.

We had many failures. These must be always expected in trying new measures, but we can trace these very especially to want of apparatus, and also notably to the proportions *advised* not being adhered to. There was an alarm as to leaves of trees dropping, but so far as report has been given me, and special report was sent at my request, this was, for the most part where over-quantity of the chemical was used.

Rather unfortunately for our steady progress, an experiment was made by one observer of giving an enormously strong overdose, which application was crowned with the *fullest success*. The caterpillars were killed and the leafage was uninjured. The reason of this was easily traceable, to the fact of such rainfall as washed the leafage clean almost immediately following; but meanwhile, encouragement was given to all who were inclined to think that if good was done by a weak application much more would be done by a strong one, and *where* overdoses took place (without accidental help from rainfall), injury followed.

The only point which has come under my notice in the enormous quantity of reporting sent to my hands on the subject, that does not appear as yet to be quite clear is whether bright sunshine soon after spraying does or does not cause it to have some degree of injurious effect. In the coming season when we may have the benefit of apparatus to throw the fine hazy moisture in the proper manner, this difficulty will probably vanish.

But we have now *proof* from thoroughly publicly tried experiments on a working scale, that here, as in America, when properly applied the Paris-green mixture will kill the caterpillars without injuring the leafage; that these operations have been followed by an exceedingly good harvesting of fruit, and this again by a good promise for next year by the amount of forming buds on the trees, and by notable diminution of Winter Moth appearance in autumn.

Our experiments have been mainly directed to, and the reports mainly concern, Paris-green. Though some observers have experimented and thought well of the arsenical preparation known as London-purple, in *these* notes and recommendations, I have strictly limited myself to Paris-green, which I can give evidence of successful use of, from the Government reports of the United States and Canada, and of publicly tried and tested experiment here.*

Nature of Paris or Emerald-green, and cautions requisite to be observed in its use.—"Paris-green" is an aceto-arsenite of copper, and of a poisonous nature, and therefore should be used with care in mixing, and should not be applied *to fruit or to vegetables that are used for food.* But, as will have been seen in the previous observations, the quantity to which it, in order to be beneficial, is requisite to limit application in spraying for prevention of moth caterpillars (see p. 86) is excessively small, and our English experiences of the past season, as well as those on the Continent of America where Paris-green has been used regularly in farm and orchard prevention for many years, show that with proper care it may be used with perfect safety.

On application to Messrs. Blundell & Spence, of Hull, as being well known manufacturers and great exporters of Paris-green, for information as to the precise constituents of this chemical, and the different names under which it was described, Mr. E. Dixon (Manager) replied to me as follows:—"Emerald-green, Paris-green, Schweinfurth-green, are different names for the same thing. The first name is

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* For paper on nature and serviceableness of London-purple see Index.

English, and is the one used in most of our Colonies, India, and China; the second is the American term; the third only used in Germany and by German traders.

"Emerald or Paris-green is a double salt of arsenite and acetate of copper,—in other words, an aceto-arsenite of copper. You may take the U.S.A. analysis of Paris-green as correct. The pure article (which is that used as an insecticide) is a true crystal, and varies in colour, from a deep to a pale green, according to the size of the crystals."

Mr. Dixon also favoured me with the following percentage analysis of pure Emerald- or Paris-green.

"Percentage composition of Emerald-green:—

	Per cent.
"Copper	32.11
Arsenic . . .	28.56
Oxygen . . .	32.48
Hydrogen . . .	0.76
Carbon . . .	6.09
Total .	100.00"

Cautions to be observed in the use of Paris-green.—The bags should be labelled Poison and kept locked up, and especially kept safely out of the way of children, who might be attracted by the beautiful colour.

Workers with the powder should not allow it to settle in any sore or crack in the skin of the hands, nor stir it about unnecessarily with the hands; and they should be *very careful not to breathe in the powder* through mouth or nose whilst measuring or mixing it.

For this reason it is most desirable that purchasers of Paris-green should have it sent *not* in bulk, to be divided for use on receipt, but wrapped in single pound (or small) packages by the senders. I particularly wish to draw attention to Mr. Dixon's observations on this head, given in his replies to my enquiries:—

"In handling this article in the dry powder, care is required, as a light green dust arises which is breathed in, and produces unpleasant results; and in one instance, a customer who thought he could save money by buying it from us in bulk, putting it up himself in paper parcels, employed a man to weigh out and wrap about 5 cwt. in 1 lb. parcels. *This cost the man his life;* so as we are laid out for this business, sometimes wrapping 10 tons a week, we can really do it at much less cost.

"We have never heard of any accident to users in America, and there is no danger when using it in water (*i. e.* from its flying about, Ed.), but you might advise any who wish to try dusting it on dry to carefully stand to windward."—(E. Dixon (Director), Messrs. Blundell & Spence, Hull.)*

* At present we especially advise that *dry dusting should not* be attempted as a remedy for caterpillar attack. We only advise fluid mixture.

In order further to remove risk from inhaling dust in process of mixing, Messrs. Blundell & Spence arranged that where wished they would slightly moisten the powder before forwarding it to the purchaser; this is the form known as "Paris-green paste," which is mentioned in the recommendations of the Experimental Committee.

In use, the above directions should be followed; in fact, ordinary care and caution should be used; like others of the poisons which are used in various agricultural treatments, Paris-green may be used without the slightest danger or damage *if* reasonable care is taken; if not, there is necessarily a possibility, in this as in other cases, of disagreeable effects or dangerous illness ensuing, or *possibly* death.

The cost of the Paris-green is very little.—The firm with whom I have corresponded on the subject inform me that, as wholesale manufacturers, they could furnish quantities of 1 cwt. and over, at the rate of 10d. per lb. Retail traders would probably not furnish the pure article under 1s. 8d. per lb.

In the use of Paris-green as a fluid dressing, or spray, one of the first points to be borne in mind is that this chemical does *not* dissolve in water. It is simply held in suspension. The powder merely mixes with the water, and unless this mixture is kept stirred, the Paris-green powder will sink to the bottom of the barrel, pump, or other apparatus, instead of being evenly distributed throughout the fluid.

For this reason it is necessary to keep the mixture in agitation during application, and also it is necessary to have the barrel "well washed out after it has been filled ten or twelve times." If this is not done the mixture will very soon be too weak at the top and too strong at the bottom, and the gradually increasing settlement will presently (in all probability) cause a seriously too strong overdose.

One great point therefore, in selection of spraying machines, is that either by mechanical contrivances (when on a large scale), or in the portable forms by arrangements which will make the movement of the bearer serve the same purpose, the mixture should be so kept in movement that the powder should not settle down. The mixture should be kept at an even strength throughout, during the whole time of distribution, and also it should be so distributed that it will be thrown as a fine spray, or mist, and will *rest and remain* both on the upper and under sides of the sprayed leafage as a fine film or dew.

It should on no account whatever be thrown so as to "swill" or "souse" the trees, and run off the leaves in drops, or streams; this is bad practice in every way. It uses a great deal more of the chemical than is needed; the leaves get little but pure water at their highest part, and much too strong application where the fluid has settled at the tips; and also a drip is caused on to the ground beneath, which may render the grass temporarily poisonous.

To recapitulate, the mixture should be of an even strength (specified on previous pages repeatedly), which strength should never be exceeded for our present consideration of spraying for moth caterpillars, and this mixture should be distributed so as to remain in the finest film of moisture. This point should always be borne in mind.

Various forms of apparatus would answer this purpose, but with regard to what has been tried and found to answer well at Toddington Fruit Grounds, in our past season's experiments, I was favoured by Capt. Corbett (in July last) with the following note:—

"The knapsack pump, or No. 1 'Eclair,' used at Toddington plantations, can be had of Messrs. Chas. Clark and Co., Windsor Chambers, Great St. Helen's, E.C., sole agents.* One great advantage is that the movement of the man keeps the liquid agitated. It is an admirable instrument, and we like it better than anything."—(R. J. C.)

On the 24th of December, Mr. J. Masters, of Evesham, wrote me regarding this "Eclair" spraying machine:—"The 'knapsack' form is everything that could be desired in producing the fine misty spray, and it is admirably adapted for trees and bushes not exceeding twelve to fourteen feet high. Above that height we must get either the Strawsonizer, or the force pump with a fine nozzle."—(J. M.)

Mr. C. Lee Campbell, also writing to me on this subject from Glewstone Court, Ross, Herefordshire, observed:—"The little French machines used at Toddington are admirable in the hands of a painstaking man, and are the only machines which I have heard of that can be used where the ground is packed, as it is there, with undergrowth of bush plants, &c. But to my mind we should leave nothing to chance;" and here Mr. Lee Campbell mentioned an arrangement of dashers which at his suggestion was being added to another and much larger form of spraying machine (mentioned further on), by means of which the Paris-green was kept thoroughly mixed in the water without depending on the care of the operator.

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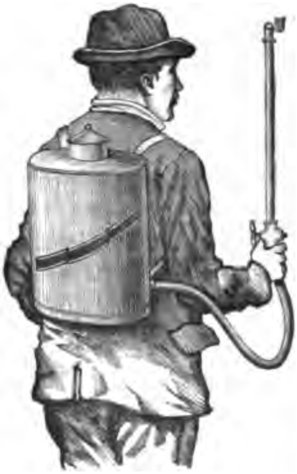
* The decease of Capt. Corbett interrupted the arrangements which he had almost completed between M. Vermorel (Villefranche, Rhone, France), the manufacturers of the "Eclair" sprayer, and Messrs. Chas. Clark & Co., the sole English agents. I therefore recently made arrangements myself that a few of the sprayers should be imported on my own responsibility (so that in case of these not finding purchasers the loss might fall on myself), and that we should not again be without requisite apparatus. The price, I understand, will in some degree depend on numbers that can be imported at once, but may be generally stated at about 35/-. All communications with regard to purchase should be sent to Messrs. Chas. Clark & Co., Windsor Chambers, Great St. Helen's, London, E.C.

The sketch below (from M. Vermorel's circulars) shows the method of carrying the "knapsack." The sample I have seen fits well and easily on the shoulders. It is a metal reservoir, solid, or rather standing on a deep strong rim below, so that when set on the ground it will stand safely, without necessitating help from a worker to hold the apparatus up whilst another fills it. A large opening, with moveable lid and wire sieve within, allows of the apparatus being quickly filled, and (when the sieve is lifted out) also permits of entrance of the hand to clean the inside, and there is automatic arrangement for keeping the mixture in movement. The distribution is effected by a hose attached to the reservoir or knapsack, with requisite arrangements and adjustable nozzle to distribute the application as a fine spray or mist. The reservoir may contain about three and a half gallons.



In the paper on insecticides recently reprinted by the U.S.A. Department of Agriculture, Prof. C. V. Riley mentions the "Vermorel nozzle" as one of the most successful of the modifications of the "Riley nozzle" used in the States. The great advantage of this nozzle is that by a special arrangement it can be cleaned inside when it becomes clogged.

Another form of spraying machine has been mentioned to me by Mr. C. Lee Campbell, of Glewstone Court, Ross, who has given great attention to Paris-green spraying on his own orchards of about 6000 trees, during the past season, as being very serviceable. It is fitted with powerful pump and two jets and sprayers, and also automatic dashers for keeping the fluid properly mixed. The pumps will draw to a height of thirty to forty feet. The barrel holds about thirty-six gallons of water.

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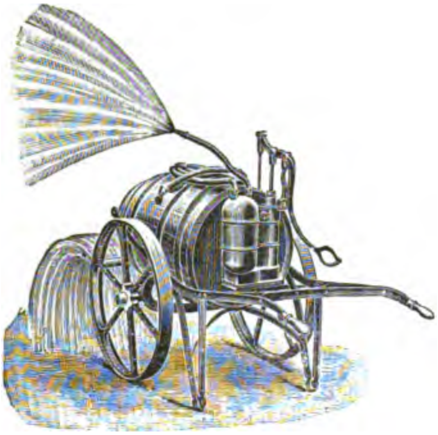
The figure below shows the method of distribution of the spray; the water flowing from the front of the barrel shows the machine as used for watering lawns, &c., but this arrangement need not be supplied unless wished.



This machine is manufactured by Messrs. Boulton & Paul, Rose Lane Works, Norwich, and the price is £8 15*s.* for the spraying machine and all its appliances, *without* the special arrangement for watering.

Of this sprayer, Mr. Lee Campbell favoured me with the following further description:—

"The barrel is of course mounted on wheels, and has a pump fixed to the rear with two delivery pipes, to which are attached whatever length of tubing (india rubber) may be necessary. Three men go with the apparatus, two men to spray, and one to pump. Should the wind, however, be rough, we cannot always use two sprayers. The two sprayers assist in drawing the barrel. The rapidity of spraying necessarily depends somewhat on the wind, because as the spray is effective at at least 50 feet in quiet weather, it follows that in bad weather we are reduced to operate on a smaller area. I am able to spray 3000 trees a day under ordinary circumstances. As to the dashers. It is impossible to trust the great proportion of labourers with the responsibility of agitating the liquid." . . . . "To my mind we should leave nothing to chance; therefore Messrs. Boulton & Paul, at my suggestion, have arranged the pump by lengthening the handle beyond the pump, and fixing dashers in the barrel attached to the handle, so that with every movement of the pump handle, the dashers are agitating the liquid. Stott's double sprayer, fixed to the end of the tubes, works admirably, and economises the liquid immensely, besides rendering it less needful for the men's hands to be constantly wet."

For work on a still larger scale, there appears every reason to hope that the distributor popularly known as the Strawsonizer, would be excellently serviceable. The successive trials of this "air drill" for distribution of dry dressings in the finest powder, or fluid dressings in misty spray, have been so fully placed before the agricultural public that there can be no reason to describe the general method of this distributor over again. But looking at the adaptibility for orchard spraying, it is satisfactory to know that both the horse power and hand power machines have, or can have, vertical delivery, both with spray and dust. With ordinary delivery pipes, 25 feet may be taken as the height dressed, but as the delivery pipes can be made any length, a much greater height can be reached if desired.

The great recommendation of this machine, for the present purpose, is the minute quantity of fluid which can be distributed in a fine dew-like spray; this, so far as experiment shows at present, doing the work we need very thoroughly, and at a low cost, excepting original outlay for the "Strawsonizer" itself.

So far as we see, the hand machine would be the most useful, and it will be very desirable to have reports given, as soon as tried, of its practical workings in spraying infested orchards.*

As the use of Paris-green has only been really taken up on a working scale amongst us during the past season, and the want of proper apparatus has been one great difficulty in our way, I am only able to give observations regarding appliances which have been brought under my notice. The spray *can* be distributed from a common garden engine, but this method involves great loss of material from quite unnecessary quantity of fluid spread abroad, and also great risk of over-application to the leafage.

Whatever kind of sprayer is used, it must always be borne in mind that the mixture must be kept an even strength throughout, and no sediment to form at the bottom, or damage to leafage is sure to happen.

In mixing the Paris-green in the form of dry powder with the water, the method recommended in Prof. Riley's 'Seventh Missouri Report, 1875,' p. 15, is a very simple one, and makes it quite unnecessary to handle the powder. The recipe is given here merely with regard to method of mixing, *not* with reference to any special proportions:—"Two bucketsful of water are first poured into the can, then three tablespoonsful of good green, well mixed with another half-bucketful of water and strained through a funnel-shaped strainer . . . . the use of which prevents the larger particles of the green from getting into the can and clogging up the sprinkler."

The exact method of mixing, however, is quite immaterial—only remembering that the powder should be thoroughly diffused through the water, not allowed to be in lumps; and also the methods are best which allow of the operator mixing without handling the powder (lest it should get into possible cracks or sores on the hands), and also give *no room for the careless and thoughtless inhaling it.* I have myself seen in a store the salesman stirring the mass up with his hand the whole time (until I directed his attention to it) that he was speaking to me. For the above reasons, and also for convenience in mixing, the "paste" form mentioned at p. 98 is preferable to the powder.

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* The address of the manufacturers is Messrs. R. Hornsby & Sons, Spittlegate Iron Works, Grantham, who will give particulars on application.

Mixture of flour with Paris-green.—At p. 88 of report of our own experiments in the past season, Mr. Masters mentions the serviceableness of the addition of flour to the Paris-green mixture. This addition is advised in the U.S.A. on the high authority of Dr. Lintner,* and also of Dr. Packard †; and the following note by Prof. Riley gives his own views clearly on the subject. Speaking of a mixture of Paris-green in 40 gallons of water, he says:—"It pays to add two or three pounds of flour or starch to the mixture, not only because of the greater adhesiveness which they give to the poison (a very desirable object, especially in wet weather), but because by their colour they help to indicate the quantity that has been distributed." ‡

Still, notwithstanding the above high recommendations, it appears to me open to doubt whether the adhesiveness which makes it a useful addition in some cases might not do harm on the very young leafage amongst which our special work lies.

The success mentioned by Mr. Masters was when the leafage was past its early state; and in the various reports I have studied of the use of Paris-green (especially as a remedy for moth caterpillar attack of a similar nature to our own in Canada), I do not find mention of the admixture of flour. Therefore I would suggest that, before trying this on a large scale, some special experiment should be made.

Where the plan is adopted of mixing flour with the Paris-green, the following method is advised:—To take a large galvanised iron funnel of capacity suited to the work; for filling a 40-gallon barrel a funnel of 18-quart capacity is noted. This funnel has inside it a kind of strainer (described as a "cross-septum") formed of fine wire gauze, such as is used for sieves, and this also has vertical sides and a rim to keep it from rocking on the barrel. The quantity wished of cheap flour is placed in the funnel, and washed through the sieve-like wire gauze by water poured in; thus the flour is finely divided and diffused in the water, and the Paris-green subsequently added and washed down in the same way by addition of the rest of the water until the barrel is full. The amount of flour used to a given quantity of water or Paris-green appears not to be very important.

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* 'First Annual Report of State Entomologist of New York State,' p. 26.

† "Insecticides," by C. V. Riley, M.A., Ph.D. (extracted from 'Fifth Report of United States Entomological Commission'), p. 33.

‡ 'Bulletin No. 3 of United States Entomological Commission,' p. 57. Washington, 1880.

The preceding observations give the main points of our work, that is, the work of the Evesham Fruit Conference Experimental Committee during 1890, carried on with such co-operation as I was myself able to give by information from Government and Official Reports for many years back, of successful methods of operation both in Canada and the United States of America, and aided also by special advice with which we were kindly favoured in our difficulties by Mr. J. Fletcher, the Dominion Entomologist of Canada.

Requirements of space only allow of insertion of a portion of the observations, but a large mass of details are in my hands, from which I shall be happy to give any information, and also may remark that in addition to the great amount of information which has long been, and still continues to be, laid before the public in the Reports of the Dept. of Agriculture of the U.S.A., on the subject of arsenical insecticides, that the increasing attention given to the method of lessening amount of insect ravage is furnishing a large mass both of evidence of their utility and details of methods of application, which may be very serviceably consulted in the reports of the Experiment Stations of the Agricultural Colleges of various of the United States, as of Ohio, Massachusetts, Iowa, &c.

London-purple.—In the past season, some amount of trial was also made of another arsenical insecticide which has long been used in America, known as London-purple. This is an arsenite of lime. A notice of the method of preparation and also analysis of this chemical, by Prof. Collier (then Chemist of the Dept. of Agriculture, U.S.A.), will be found at p. 149 of the 4th Report of the United States Entomological Commission, followed by report of the results of trial of the "purple," of which a number of barrels had been placed at the disposal of the U.S.A. Government by the liberality of the manufacturers, Messrs. Hemingway & Co., in 1879.

The analysis given is as follows:—

	Per cent.
Rose aniline	12.46
Arsenic acid	43.65
Lime	21.82
Insoluble residue . . .	14.57
Iron oxide	1.16
Water	2.27
Loss	4.07
Total .	100.00

The "purple" may be used either as a powder dressing, or it may be mixed with water, or water and flour, and sprayed on the trees just in the same manner as Paris-green, but it is stated that owing to its lightness a far smaller quantity by weight of London-purple will treat a given number of trees than would be required of Paris-green.

One great difficulty in its use in America has been that where it is purchased without due caution, merely as a " waste product" that could be had for six cents a pound, or for cost of carriage, there was liability to such differences in strength as to lead to much mischief where applied without previous testing as to effects.

It is therefore very desirable to purchase direct from the manufacturer (who will furnish analysis) in the case of large quantities, or where only small quantities are needed, such as must necessarily be procured from retail dealers, either to procure a statement of strength (*i. e.* analysis), which could be had by the retail dealer from the manufacturer, or to make careful trial of proportion safe to use, before a general application.

In the note regarding this point with which I am favoured by Messrs. Hemingway & Co., of 60 Mark Lane, London, E.C., who have long been manufacturers and exporters of this chemical, they mention that " four ounces of London-purple (owing to its lightness) will treat the same number of trees as sixteen ounces of Paris-green."

This is a matter to be well borne in mind, and in our present state of knowledge of effects of this chemical in England, careful experiment should always be made by new experimenters as to effects, before spraying on a large scale. Also, in a quotation from Dr. Packard in the recent issue of "Insecticides," at p. 83, referring to London-purple and Paris-green, it is noted :—"As the effect is slow in appearing, impatient parties will be apt to re-poison on the second or third day, and thus put on enough to hurt the plant when the effect does come. Much depends on dryness or wetness of the weather; but good effects may be expected by the third or fourth day." *

Amongst the points in which the London-purple is considered to have advantage over Paris-green is, for one thing, its lower price. Looking at returns in my hands from leading manufacturers, wholesale prices are stated for the green, as at per cwt., at 10d. per lb., for the purple per cwt., at 7d. per lb. This of course I give only as a general guide; purchasers would receive definite information from the manufacturers.

Other desirable points are its greater diffusibility in water, also its greater adhesiveness to the foliage, and also that this "purple" or arsenite of lime is stated not to be so poisonous as the " green " or arsenite of copper, although, like the green, the purple *is a poison*, and is to be treated and used with the precautions and care mentioned at p. 97.

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* 'Insecticides and means of applying them,' &c., by C. V. Riley, M.A., Ph.D., rom Fifth Report of U.S. Entomological Commission.

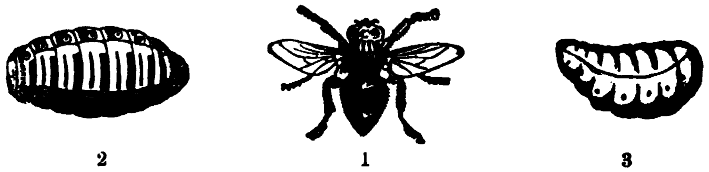
In the above observations I am only speaking of the London-purple in the powder form, used in the same manner as Paris-green powder or paste. Looking at the great mass of evidence attainable in U.S.A. Reports for many years, and other sources, it appears to me that there have been many failures, and sometimes direct injury caused, these failures often to be attributed to the strength of the "purple" being not known, also the operator not having proper apparatus, and also being altogether careless in learning how to apply the spray or to experiment on a tree or so, before proceeding to broadscale work.

On the other hand, there has been such thoroughly good success, showing what *can* be done with proper care, that it would be very desirable for further trial to be made with details duly noted, of strength of powder, proportion used, nature of sprayer with which applied, and results.

Any details which it is in my power to furnish, I shall give with pleasure; and I should fail in courtesy if I did not express my thanks to the heads and managers of the different great firms whose names I have mentioned, for the prompt and courteous attention with which they have uniformly replied to all my enquiries.

OX.

Ox Warble. *Hypoderma bovis*, De Geer.

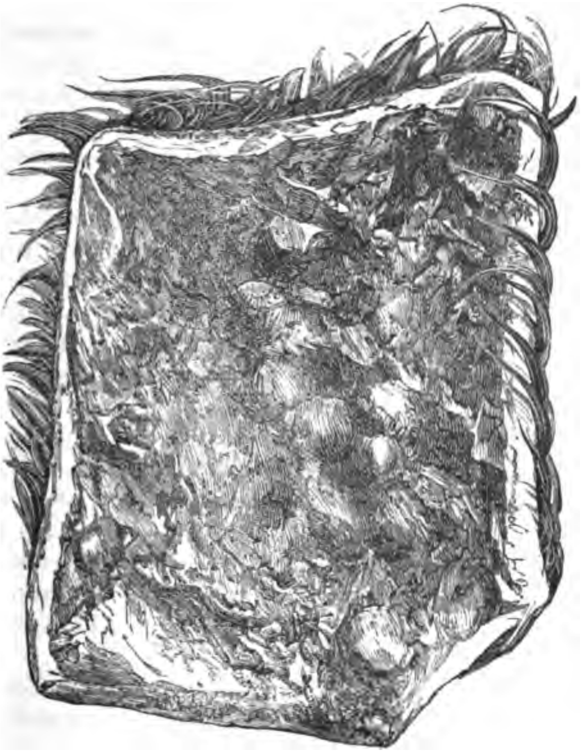


1, Ox Warble Fly; 2, maggot; 3, chrysalis.

During the past year, there has again been much application for information as to the best methods of prevention and remedy of Warble attack; and (also as in previous years) the enormous and perfectly unnecessary loss caused to tanners and hide firms, to butchers and farmers, by this most unnecessary attack, has again been brought strongly forward by those interested. But still the difficulty remains of getting the information home to those immediately interested about the cattle, and to those in out-of-the-way districts, who, having no means of hearing of advance of knowledge of the nature of the attack, still hold to the beliefs of bygone times as to health bumps, maggots being generated by high feeding, &c.

Very many would be thankful to have the simple information needed in their hands; and though, also, there are many who for sheer idleness, or desire to get a warbled beast sold at the price of a good one, wilfully misrepresent the state of the case, yet with the spread of knowledge the evil could not fail to be lessened; and I should be happy, whether for private use or for distribution, to continue to forward to applicants copies of my leaflets on Warble attack; also on the condition known as "Licked beef" arising from bad Warble presence; and the means found serviceable in lessening these troubles, namely, Warble presence and its consequences.

The following letter with which I was favoured on the 12th of March, by Mr. Chas. Crossland, Treasurer of the Halifax and District Butchers' Association, gives some very suggestive observations on injury to meat from Warble presence, and the "jelly" or slubber accompanying; and the need of more widespread information as to the nature of the infestation.



Piece of under side of warbled hide; Warbles about half size. From a Photo by Messrs. Byrne, Richmond, Surrey.

Mr. Crossland wrote:—"Just now warbled beasts are unfortunately coming plentifully to hand. One of our Halifax firms had 20 beast dressed last week; out of these no less than 12 were warbled, one of them badly, having about 40 maggots on its loins and crops, or fore chine. This week 8 were dressed for another firm, all of which were affected with this horrid maggot. They were all to pare down, more or less, to rid the beef of the accompanying undesirable jelly. In some cases 1 lb. would clear the beef, in others as much as 4 or 5 lbs., and in bad cases even more than this had to be cut away before a presentable surface could be got at.

"The parings of course had to be thrown into the tallow bag for melting purposes; this means a loss in money value of 8d. to 9d. per lb., the grub and its concomitant 'slubber' always affecting the most valuable portions of the carcase. Even the tallow chandler prefers its absence to its presence amongst the rough fat.

"Several of our wholesale carcase dealers purchase foreign cattle at Newcastle; these appear to be free from Warble, at least I have not noticed any so far.

"Some of the pamphlets received from you were taken direct to the farms of several graziers and feeders, by one of our butchers who purchases most of their stock. He impressed upon them the desirability of using every endeavour to keep down this destructive and pain-producing pest. There was the old notion still held by some of the farmers that the origin of the maggots was spontaneous in the beasts' backs.

"The other day I was talking with a man on the subject, who has been brought up at a farm, and who also has learnt the occupation of slaughterman. Though he had taken off thousands of hides, he had no other idea than the one quoted above, that the grubs originated in the beasts, the lump he compared to 'boils,' and the maggot to the 'knot.' He could scarcely credit the explanation I gave to him of their presence beneath the hide."—(C. C.)

Another communication on the same subject, sent me by Mr. James Barnett, 81 King Street, Ulverston, Clerk to the Ulverston Hide and Skin Auction, together with a request for leaflets as to prevention of attack, shows the extent to which "jelly" may spoil the best part of the beef:—"We slaughtered a bullock last week and I am sure we had quite half a stone of jelly to dress off the back, before it could be sent out; also a heifer yesterday which had one of the worst warbled backs I ever saw."—(J. B.)

The following note sent me from Nunthorpe Court, York, on the 15th of May, gives another example of the severe injury which is liable to be caused by Warble, and which a very little knowledge of the nature of the attack would show the remedy for at once:—"You may be interested to hear that a heifer, 3 years old this summer, has been doing very badly; and though I have had two or three tenant farmers who keep cattle on a large scale here to see her, none of them suggested any reason for her not thriving, while the other cattle, Irish beasts, are rapidly getting fat.

"Since reading your pamphlet to-day, I went down again to see her, and notice that she has a mass of Warbles on both sides of her back. I knew she had some, but thought little of the matter; at a rough guess there must be well on for a hundred Warbles. I shall treat her to McDougall's smear to-morrow."—(R. F. M. T.)

On the 19th of May I was favoured with the further detail:—"Out of the heifer that I mentioned as doing so badly, we have extracted 65 Warbles, and there are several more still to be exterminated." . . . . "Now that I am alive to the injury they cause, I shall take good care in future to kill them as soon as their presence is recognised."

The conditions of locality, as exposure, or possibility of shelter in hot sunshine beneath trees or sheds, dry pasture land, or plenty of access to water, make a difference in amount of attack, but these arrangements do not lie, excepting to a small extent, at the disposal of most farmers. A correspondent in Kincardineshire noticed the large amount of Warble presence, which he conjectured was partly caused by the open nature of the pastures merely divided by wire fences.

In the following note with which I was favoured by Prof. John Wrightson, President of the College of Agriculture, Downton, Salisbury, he notes absence of Warble attack under circumstances of the cattle having access to, or being in the neighbourhood of, water, which point (that is, the objection of the fly to crossing water) is specially brought forward by entomological writers.

Prof. Wrightson observed:—"On May 24th I examined most of our dairy of about 27 cows for Warble maggots. Two cows only were affected, and both of them had been purchased into the herd last autumn, and from them I extracted five large larvæ, leaving a considerable number to mature a little further as they would not then come out on pressure applied around the part affected. Although I am not prepared to say there was no Warble on any of our home-bred stock, or upon those which had been here above a year, yet I can say that all those I examined (about 24) were quite free from Warble. I also notice that our cattle do not show any signs of distress in summer, at the season when *Œstrus bovis* is on the wing. I attribute this immunity to the fact that our farm is bounded by the river Avon all along one border of our grazing ground, while open ditches, full of water, traverse the pastures in several directions. A large proportion of our dairy land is water-meadow, and the valley is literally 'a land of streams'; and this, I expect, is a barrier to the Warble Flies, for I understand that, like the elves and goblins of the highlands of Scotland, 'a running stream they dare na cross.'"

These local circumstances, however (for the most part), can be but little altered or modified, excepting by allowing cattle, so far as may be, access to pools, or to shelter under trees, or in open sheds.

But where the simple remedy of squeezing out the maggots, or getting rid of them by any other way preferred is carried out, *there at once* is demonstrable benefit to the cattle, and when really carried on year after year in a district, it will keep the amount of Warble presence (under ordinary circumstances) well down. I use the words "*really*" and "under ordinary circumstances," because if an application is merely smeared about on the hide, without being sure that *each* Warble hole is properly dressed, or again, if infested cattle are introduced, infestation will not be got under.

In the district round Tarporley (Bunbury, Cheshire), which I have reported since 1886 inclusive,—in which the boys of the Aldersey Grammar School, under the encouragement of their much respected Head Master, Mr. W. Bailey, have yearly cleared the cattle belonging to their fathers or relatives,—the presence of Warble maggots, that is, those counted as destroyed in the report sent me on May 21st, was 827 maggots to 675 head of stock examined. This gives an average of 1 maggot and about a quarter to each animal. This is a very different state of things to that preceding the beginning of our work, when the Warbles were stated to be as plentiful as blackberries; and where, in 1885, one boy alone brought in 250 maggots. The return is from numbers varying from a few, or from one cow up to herds of 102 and 119 animals, and the following observation was sent me accompanying, by Mr. W. Bailey:—

"I am sure it will be gratifying to you to learn that there is no falling off in interest and perseverance in the work which we have on your suggestion taken up.

"You will notice that the boys have examined 675 head of stock (*100 more than last year*), and that after a most persistent search they have discovered 827 maggots, *250 less than last year*, a very decided improvement. In cases where the maggots were not ready for squeezing out they were killed, as in previous years, by applications of the smears prepared by Messrs. McDougall Brothers, and Jeyes' Sanitary Compounds Company, Limited.

"Our experience of past years is confirmed again, namely, that the cattle which have been carefully dressed in one year are free from attack in the next year, and that the pests are found in newly bought stock where no care has been exercised, and in the young cattle which had not been dressed because they were out in the field."—(W. B.)

Where the remedies advised have been tried there has been general success. The names of the leading cattle owners and agriculturists in England, Scotland, and Ireland, whose trial and approval of these I have been permitted to give year after year in my Reports, speak as to the benefit of the treatment suggested both for lessening amount of Warble presence, and also of summer galloping, much better than anything I can say. But still the area over which care and benefit takes place is as nothing to that over which there is none.

Last season's Warble attack (so far as reported to myself) was very bad in home grown hides, also much observed in hides imported from America. Just by way of giving one or two observations on this point, on the 30th of Dec., Messrs. C. H. Hatton, writing from Barton Tannery, Hereford, mentioned, "The cattle were worse than ever this year as regards maggot."

The following note with which I was favoured from the Bristol and Western Counties Butchers' Hide and Skin Co., by Mr. W. Willis, shows the great amount of damaged hides received:—

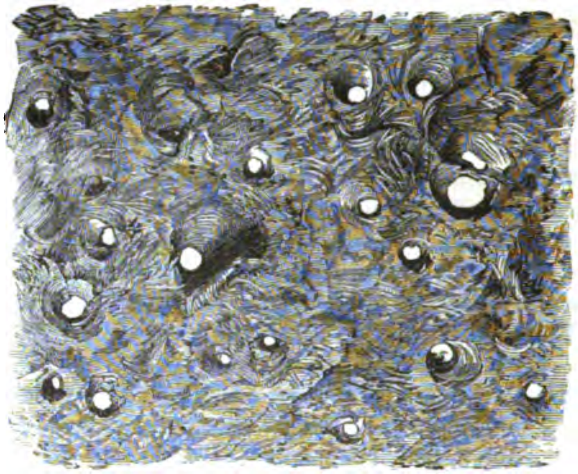
"Respecting 'Warbled Hides,' I regret to say there is but little, if any, improvement in this district. Whether it arises from the long dry and hot summer we had last year I do not know, but there is scarcely a hide brought into the market that is absolutely free from them, and many of them are as full of them as they can hold.

"I may say, too, that the hides we are now getting from the United States are worse in this respect than I have yet seen them. This is especially so with cattle exported from Portland (Maine); during the last two or three weeks there have been a considerable number of bulls sent from there, and most of these had Warbles in them by the hundred, which were of an extremely large size."

There does not appear to be any use in again, this year, going over from reports the same points that have been given yearly; the matter stands, 1stly, that the attack causes millions of pounds sterling of loss yearly; 2ndly, that it can with certainty and with little expense or trouble be enormously lessened; and 3rdly, that on account of the loss on hides, beef, and return of milk and condition of fatting beasts, it is greatly the desire of Hide Societies, Butchers' Associations, and leading cattle owners and farmers, that the attack should be stamped out.

I know no better way to help this cause than by continuing to spread plain information, and in this matter add the words of the Treasurer of one of our North Country Butchers' Associations as being more forcible than my own:—

"I don't think I can suggest any better reasonable method of dispelling the ignorance of some cattle growers than the distribution of the leaflets. If the farmers and graziers would only carefully study them, much of the mistiness which appears to envelope the intellects of some of their number in regard to this fly would be cleared away.



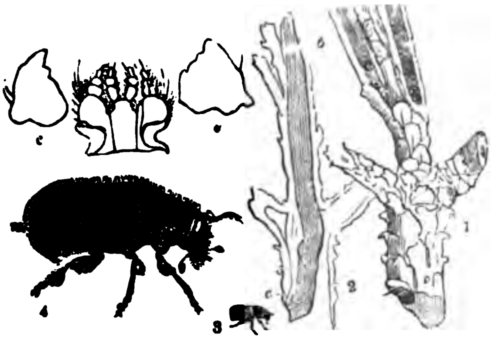
Portion of inside of tanned warbled hide.

"Buyers of their cattle ought never to miss an opportunity of drawing their attention to the leaflet. (Butchers are negligent as well as farmers.) The descriptions of the fly and maggot are so clear, and the remedies so easily procured and so very cheap, that nothing but downright idleness, ignorance or wilful neglect, can account for the prevalence of this fly. If a determined stand was made by all tanners not to buy warbled hides, we butchers would soon turn our faces from beasts with warbled backs and purchase only at a figure allowing for the hide. This kind of thing would best tend to bring negligent feeders to their senses, and cause them to keep a better look-out over their persecuted stock. Of the enormous number of leaflets distributed, very many must have come into hands which have followed the instructions and greatly benefited thereby. But dispelling ignorance of any kind has always been a slow game."—(C. C.)

The leaflets referred to (namely, one on Warble attack and means of prevention and remedy, and one on "Licked Beef," both fully illustrated) I shall be happy to continue to send gratuitously to all applicants who desire them for use themselves, or for distribution.

PINE.

Pine Beetle. *Hylurgus (Hylesinus) piniperda*, L.



1, 2, Pine shoots pierced by beetles, in section; 3, 4, Pine Beetle, nat. size and magnified; *e e*, jaws; *f g*, chin, with feelers, &c.

The following notes are given with reference to observation of the presence of the Pine Beetles for breeding purposes in the Larch.

This beetle has long been known to attack various kinds of Pine, as the Weymouth Pine, and the Silver Fir, and most especially the Scotch Fir, to which it is often seriously destructive. The life-history is for the mother beetle to tunnel a short gallery beneath the bark (see fig. p. 114), along each side of which she lays her eggs. The legless whitish maggots which hatch from these eggs eat their way onwards in, and partly beneath, the lowest layer of the bark, directing their course away from the mother gallery; each maggot widening its own little tunnel as it proceeds, so as to accommodate its increasing size. At the end of their tunnels the maggots turn to pupæ, and thence to beetles, which pierce their way through the bark and may be expected to appear about July or onwards.

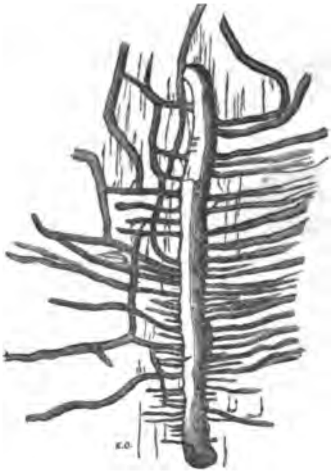
The beetles are of the shape figured above at "3" and (magnified) at "4," of a pitchy colour when mature, rough, punctured, and hairy, and (as shown at "e" magnified) furnished with strong jaws.

The great mischief caused by this attack is from the beetles when developed flying to the growing trees, especially Scotch Fir, and, after piercing into the live shoots, boring a little way along the central pith. Thus the shoot is destroyed and the natural growth of the tree altered, especially where the leading shoot has been attacked. From the pruning or dressings back which they thus inflict on the attacked trees, the beetles take their German name of "Wald-gartner," equivalent to wood or forest gardener.

For breeding purposes the Pine Beetle selects by preference felled or fallen trunks or branches where the sap is not in healthy flow.

Where this is in full vigour the turpentine would run into the freshly eaten out galleries so as to choke and destroy the eggs and maggots.

The life-history has been given at length in previous Reports, but I repeat it again relatively to the exceedingly interesting circumstance of the occurrence of this attack to Larch having recently been observed, for the first time on record, in such low latitudes as those of Scotland by Dr. Somerville.*



Tunnellings of Pine Beetle.

In the course of the past season I was favoured by Dr. William Somerville, Lecturer on Forestry in the University of Edinburgh, with a copy of the paper read by him before the Royal Society of Edinburgh, on July 7th, 1890, containing his personal observations of the workings of *H. piniperda* in his own Larches on the estate of Corniston, in Lanarkshire; and by kind permission of Dr. Somerville I give the following extract from the paper, followed by some further observations with which he favoured me :—

"The special point that I wish to bring before the Society relates to a case of the common Larch being made use of by *Hylesinus piniperda* for purposes of oviposition. As occasion demands, this insect has been found to utilise as a breeding place every species of *Pinus*, but, so far in Europe or North America, no case has been noted of any trees belonging to the genus *Larix* having been similarly attacked. In Asia an observer, namely, Middendorff, has recorded one case which came under his notice in the district of the Boganida, in Siberia, in 71° north latitude ('Sibirische Reisen,' Band iv. Theil i. p. 608).

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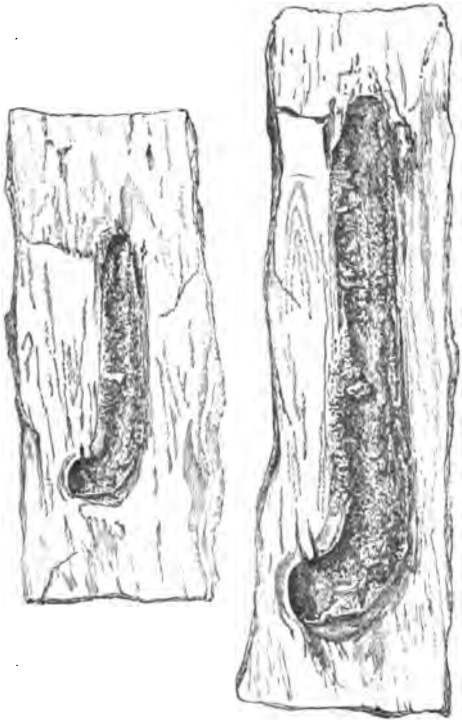
* In the 'Praktische Insekten Kunde,' of Dr. E. L. Taschenberg, at p. 205 of pt. II, the writer adds to the mention of various kinds of Pine liable to infestation of this beetle, that it occurs "high up ('hoch oben') in the north, even to the Larch."

"In the beginning of April of this year, in the Upper Ward of Lanarkshire, on a south-west slope, at an elevation of some 800 feet, I found that several Larches, which had been felled during last winter, were attacked by large numbers of this insect. In its company I also found *Hylastes palliatus*, but by far the greater number of galleries were the work of *Hylesinus piniperda*. During the past three months these trees have been kept under close observation, with the result that I find one or two particulars in which the attack of this insect on the Larch differs from its mode of attacking the Scots Pine.

"The greater abundance of fluid resinous matter in the Larch, as compared with the Scots Pine, seems to have considerably interfered with the work of forming galleries. I noticed that all the trees lying in the wood were not attacked, but only those at one side, where they were within the shade cast by a dense wood of Pines situated to the south. This I believe to be due to the fact that the cambial activity and formation of resinous solutions were retarded in these trees owing to their not being directly reached by the sun's rays; whereas the cambium and cortex of those trees fully exposed to the sun were so saturated with resin as to be safe from attack. Even in some of the



Mother galleries of *H. piniperda* beneath Larch bark, nat. size and magnified. From Dr. Somerville's specimens.

trees attacked I found unfinished galleries quite full of resinous secretions, and containing the dead bodies of the male and female insects, which had doubtless been drowned or suffocated by the resinous exudations."[*]

Dr. Somerville kindly favoured me with a piece of Larch bark containing several good examples of the mother galleries of the Pine Beetle, the *H. piniperda*, one of which I had most carefully figured, so that the wood engraving (p. 115) gives a precise representation of it, both nat. size and magnified. These figures show how the flow of turpentine, now hardened into an irregular coating, has in this instance stopped development of the little maggots, although, if carefully examined, the figure shows a row of little scallopings or niches along the side of the gallery from which, under favourable circumstances, the larval galleries would have been commenced. It will be observed that Dr. Somerville draws attention markedly to the presence of sap in active flow being a powerful agent in prevention of attack, even to the extent of some of the galleries being "quite full of resinous secretions, and containing the dead bodies of the male and female insects." This point of resinous flow demonstrably as well as theoretically stopping attack was of such practical interest, that I wrote further about it to Dr. Somerville, who kindly replied to me (9th Dec.):—

"I delayed answering your letter till I had made another examination of the Larch trees, and I am now able to answer your questions fully. The trees which were attacked by *H. piniperda* were taken possession of by great numbers of this insect, which laid its eggs in little niches as usual; these in due course hatched out, and the larvæ proceeded to eat into the bast, but the resin had proved too much for them, for in no case (at least in no case that I have observed) did they develop into beetles.

"Whether it is possible for this insect to use *Larix* as a breeding place *successfully* or not remains to be shown. Middendorff in his 'Siberische Reisen,' says the Larches were quite full of the galleries of *H. piniperda*, but he does not say whether these were mother or larval galleries."—(W. S.)

These observations appear to me to be very interesting, not only as chronicling a first record of infestation in a new geographical locality, but also as a reason why it is very unlikely to appear in the phase injurious to the living tree. Also it shows us the perfect correctness of the principle we work on to keep the attack of the Pine Beetle, *H. piniperda*, in check on the plantations of Scotch Fir, to which it is mainly (and often very seriously) injurious.

It frequents for breeding purposes felled trees, or broken branches, or (very notably) the choppings of wood with bark on, which are too often left lying about where plantations have been thinned and the poles dressed on the spot. In these, and in similar situations, where there is still sap present, but it is not in sufficient flow to fill the galleries, the beetle makes its breeding tunnels, and the maggots develop to maturity. Therefore removal of all such nurseries, or placing pieces of wood with bark attached to attract the beetles, and clearing away these and destroying them, are amongst the best methods of preventing mischief from this attack to the live Pine shoots.

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[*] "*Larix europæa* as a breeding place for *Hylesinus piniperda*," by William Somerville, D.Œc., B.Sc. (Read July 7, 1890.)

Excepting where the tunnelling beneath the bark for breeding purposes accelerates the destruction of an already unhealthy tree, this part of the infestation is rarely seriously injurious. It is the boring of the beetles up the centre of the Pine shoots which is the great cause of damage.*

What has been the cause of this heretofore (so far as we are aware) unknown occurrence of attack of *H. piniperda* to Larch in Scotland, we cannot be absolutely sure of. It will be seen, in the following extract, that Dr. Somerville attributes it to the enormous quantity of forest insects which, from special circumstances, were for a while present in the South of Scotland:—

"As to the cause of *H. piniperda* attacking the Larch, I believe a satisfactory reason can be given. About ten years ago the southern counties of Scotland were visited by a succession of exceptionally severe gales, which overturned enormous numbers of Pines and other trees. Partly owing to the glutted state of the market, and partly to the difficulty experienced in dealing with such a large amount of fallen timber, the woods were allowed to remain undisturbed in their devastated condition for a number of years. These dead and dying trees furnished an exceptionally favourable breeding place for *H. piniperda*, which consequently increased at a prodigious rate, each average sized Pine being capable of producing, it is said, as many as 80,000 insects. Within the past year or two the last of this fallen timber has been removed, with the result that the huge army of forest insects, by which the country is over-run, cannot be accommodated with the breeding places which they prefer, and have therefore been compelled to oviposit on what they must consider most unsuitable material.

"Thus, owing to stress of circumstances, *H. piniperda* has been driven to attack the Larch, and in this country I have also found Scots Pines, not exceeding eight years of age, infested by it, although hitherto trees of a less age than fifteen years have seldom been known to be attacked." †

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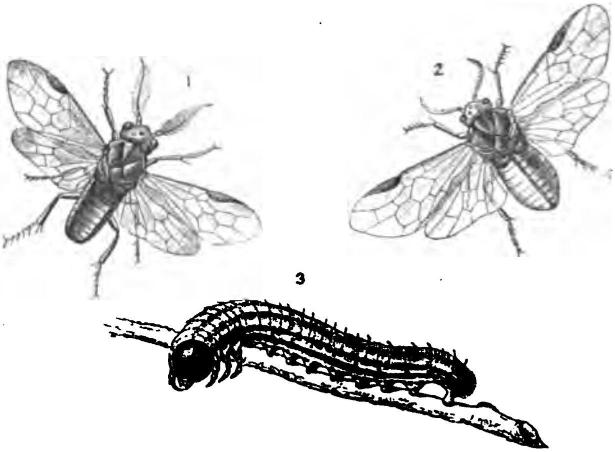
* Observations on methods of prevention and remedy, mainly contributed by Scottish Head Foresters, have been given in previous Reports, and in my 'Manual of Injurious Insects.'—Ed.

† See paper by Dr. Somerville previously quoted.

I am not able myself to offer any trustworthy opinion on this point of the cause of infestation of the Larch, but no other cause suggests itself. Dr. Somerville, having made both forestry and the Coleoptera his special study, has excellent knowledge of the subject in all its bearing, and has secured to us a valuable as well as interesting observation, in his careful notes of record of presence of the *H. piniperda* in *Larix europæa* in the South of Scotland.

Fox-coloured Pine Sawfly. *Lophyrus rufus*, Klug.



LOPHYRUS RUFUS.
Fox-coloured Pine Sawflies, 1, male; 2, female, after Prof. Westwood; caterpillar after Dr. Hartig, all much magnified. Nat. size given in descriptions.*

On the 10th of June in the past season, Mr. W. Clark, writing from Stronechreggan, Fort William, N. B., forwarded me specimens of caterpillars as samples of an infestation which was doing much harm to the leafage of young Scotch Fir plantations, over a large area under his management at Conaglen, Ardgour, Argyleshire. On examination these proved to be Sawfly caterpillars, not, however, of the *Lophyrus pini*, the "Common Pine Sawfly" (only too well known for the severe injury often caused by its caterpillars to the leafage and young shoots in Scotch Fir plantations), but of a less frequently observed kind, the *Lophyrus rufus*, or "Fox-coloured Pine Sawfly," so called from the reddish colour of the females.

The above named two kinds of caterpillars are very similar in their habits, and may be found doing mischief together; and in the following note those that are mentioned as green, which were noticed in 1888, may have been of the "common" kind, but the greenish grey specimens sent to myself in 1890, some of which I reared to the perfect insect, were of the *Lophyrus rufus*. Mr. W. Clark wrote as follows:—

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* The above figures of the male and female Sawflies are copied from the very beautiful figures by Prof. Westwood, given on plate xxxv, vol. 7 of 'Illus. of British Entomology,' by J. F. Stephens. The caterpillar is from plate iv of 'Die Blattwespen und Holzwespen,' by Dr. Th. Hartig.

"Here we are very much troubled with a small green caterpillar eating the needles off the young Scotch Firs. In 1888 they were present but in insignificant numbers, but last year, and again this, they are in thousands—I might say millions. They devour all the needles of last year's growth, and till this year did not touch the young shoots of this year's growth at all, but I am sorry to say that this year they *are* eating the young shoots, which must do far more injury to the tree. They begin their ravages about the first of June, and are all away by the end of the month. They are found in large bunches at the end of every twig, having apparently eaten their way outwards. No special part of the tree is attacked first; they can be seen on the highest branches on one tree, and on the lowest on the next, and some trees escape altogether."

A little later, on the 21st of June, Mr. W. Clark further mentioned:—"I notice that the trees that are well grown, and are, say, about 10 ft. high, are not attacked with the same virulence as small trees from two feet to six feet high. In fact only in rare cases are the larger trees attacked at all, and then only at the very top, the caterpillar appearing principally round two or three last year's growths there.

"Age by no means saves an attack, however, as badly grown trees, ten years old and upwards, may be seen stripped entirely, and those planted at the same time (but on a piece of good ground, well-grown, and perhaps three times as large) entirely free from the pest and in vigorous health.

"For the one case, the last year's growth may be about two inches long, and I notice that said growth is every year, since caterpillar made its appearance in such numbers, growing less; in the other case of the healthy tree, the shoot may be nearly a foot long."—(Wm. C.)

The caterpillars sent me corresponded in size, colours, and markings, with those of the Fox-coloured Sawfly, the *Lophyrus rufus*, Klug. These are of dusky greenish grey colour variable in depth of tint, with black heads, a fine light line along the back, and a dusky line bordered with a white line above and below, running along each side, in the lowest of which white lines the spiracles are placed The abdominal sucker feet, and the abdomen below, light green, and like others of the genus *Lophyrus*, these (including claw and sucker feet) are 22-footed. They may be as much as an inch long; my specimens were about five-eighths. "When moderately magnified, the skin appears wrinkled across and covered with very short stiff black hairs." *

By June 23rd a number of the caterpillars sent had formed their cocoons. These were rather more than a quarter of an inch in length, cylindrical, bluntly obtuse at each end, the colour pale ochrey.† Some of the cocoons were placed on the Pine twigs, and some on the sides of the box, either singly or up to as many as four cocoons together. On the 9th of August (or previously), the imago was appearing, as I then found it alive as well as dead in the box. These Sawflies proved to be of the *L. rufus*, Klug. They are of the shape figured, magnified, at p. 118, and the following description of them is given in Stephens' 'Entomology':—

"Male, with body depressed, somewhat linear shining black; abdomen beneath (except the apex), and the legs, testaceous red; antennæ twice the length of the thorax, sword-shaped with 25 rays on each side, and a simple joint at the apex; wings hyaline, anterior with a faint brownish stigma.

"Female, with the body subcylindric, elongate, and entirely of a testaceous red; antennæ black, 28-jointed, the 2 basal joints testaceous.

"The thorax and the base of the abdomen are occasionally spotted a little with black. Length of body of male 3½, of female 4 lines." ‡

The time of appearance of the perfect insect is noted as from about the end of August to October. Hartig mentions that he bred the Sawflies in the middle of September, from hybernated cocoons (of course of the previous winter) collected from beneath Moss; from caterpillars which fed on the young Fir, and spun up at the end of June, the Sawflies appeared in one instance in the beginning of October, in another at the end of August.

The eggs are stated by Kollar to be laid in the Fir leafage, in the same manner as those of the Common Pine Sawfly. That is, that the female makes a slit with the saw-like ovipositor (from which the Sawflies take their name) along the Pine leaf, and in the narrow hollow she lays the eggs, which she then covers up with a mixture of a tough resinous material and substance scraped from the leaf. From the observations of Hartig, Taschenberg and Kollar, there only appears to be one brood of caterpillars, that which is found on the trees towards the end of May and in June. Whether this is always so I do not know, but these observations agree precisely with Mr. Clark's, given at p. 119, "They begin their ravages about the first of June, and are all away by the end of the month."

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* These caterpillars vary in marking with age and condition, as—whether the caterpillar has lately changed its skin or is about to do so. My specimens varied much, but in essentials agreed with the descriptions of Hartig and Kollar, and may be distinguished by the above notes of colouring from those of the Common Pine Sawfly, noticed in previous Reports.—Ed.

† This colour is described by Hartig as "a clear yellow, with more or less of a red tint sometimes appearing through it."—'Die Blattwespen und Holzwespen,' von Dr. Th. Hartig, p. 165.

‡ 'Illus. of Brit. Entomology,' by J. F. Stephens, F.L.S., vol. vii. p. 21.

On enquiry as to the position of the cocoons, Mr. Clark wrote me that they were found amongst Moss and Heather, but as far down as it was possible for them to be without being covered with earth.

PREVENTION AND REMEDIES.—These are the same which are found serviceable for clearing infestation of the Common Pine Sawfly caterpillars, and which have been mentioned in previous Reports. So far as merely getting rid of the caterpillar has to be considered this may easily be done; but in some cases there is great difficulty in bringing these measures to bear, partly because of the expense that would be entailed in clearing the great extent of plantation infested (in the Argyleshire attack, of which the above notes are given, this was three to four thousand acres), partly also on account of the disturbance to the Heather, in one of the best methods of prevention, lessening its use as a shelter for game.

One of the regular methods of prevention where circumstances allow is, after Pine Sawfly caterpillars have disappeared from the trees on which they have fed, to turn over the surface of the ground beneath, to find whether the little yellowish or brown cocoons, about as large as a small pea, are lying beneath; if so, how deep they lie. Then if desirable they may be collected and destroyed. Where trees are large enough to have (as is often the case with Scotch Fir) little beneath but fallen leaves, rubbish, or small growths, and the extent o wood is moderate, this plan answers well.

Stripping off the caterpillars, by means of a man with a well-gloved hand taking firm hold of the infested shoots and squeezing the caterpillars, has been found to answer. Of this Mr. W. Clark wrote, "I am strongly in favour of hand stripping, as being most effectual, but it takes too much time."

The various methods of prevention of attack, or of remedy when established, which have been found successful on moderate sized tracts of ground, and which are advised by Scottish foresters, have been given in my previous Reports and 'Manual.' *

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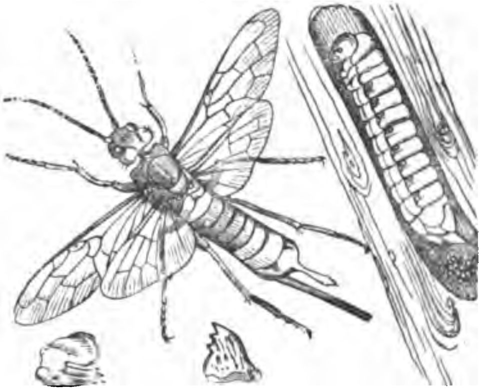
* Mr. P. Cameron mentions of this species, under the synonym now used, of *L. sertiferus*, "The larvæ are found in May and June; spin up towards the end of June, the flies appearing in August to October, when no doubt the eggs are laid, remaining undeveloped till the following year."—'Mon. of Brit. Phytophagous Hymenoptera,' vol. iii., p. 82.

Giant Sirex, "Wood Wasp." *Sirex gigas*, Linn.



Female "Wood Wasp" and maggot. Jaw of maggot, with four sharp, narrow teeth; and jaw of fly, with three broader teeth, both magnified.

During the past season specimens of *Sirex gigas* have been sent me as doing much harm in Lord Meath's woods, at Kilruddery, Bray, Ireland; likewise by Lady Frances Doyne, from timber at Wells, Gorey, Wexford (also on the east coast of Ireland), and from Mr. Empson Jones, of Woodside, Hacketstown, Carlow, a locality lying some miles further inland between the two above named places.

This insect, which is now well known as injurious to Pine timber in England, was noted in 1850 by Prof. Westwood as being then generally regarded as of very rare occurrence in this country. During the last few years it has been much more noticeable here, but I am not aware of it having been recorded as present in Ireland. The insect and its attack appear to have been previously quite unobserved at the three not very distant localities mentioned, and excited a good deal of well founded uneasiness as to the amount of mischief that might be caused if the infestation spread.

In one of the communications from Woodside, Hacketstown, Mr. Empson Jones mentioned, on the 7th of August:—"I could not see a single male flying about, but saw several females, and the males were far more numerous in the timber three weeks ago than the females. From the quantity of timber destroyed, they must be very numerous this year." *

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* The male is easily distinguished by the absence of the ovipositor; the colouring is given in Stephen's 'Entomology' as, "abdomen luteous, the 1st and last segment and its appendage black; the hinder pair of tibiæ and tarsi fuscous, pale at the base." In the specimens of the male sent me, the colouring between the black extremities of the abdomen was of such a reddish tint as to be indistinguishable from that of males of the *Sirex juvencus*, which I have received accompanying their blue-black females. I did not, however, observe any blue tint in the black abdominal markings of these males, nor were any females of the "Steel Blue" Sirex (the *S. juvencus*) sent me.—Ed.

Specimens of timber pierced by the great galleries of the grubs, sent me by direction of Lady Frances Doyne, showed great injury, and likewise that the infestation was in condition to extend, for a female "Wood Wasp" was lying almost ready for flight in one of the borings.

Together with the specimens sent me from Hacketstown, by Mr. Empson Jones, he mentioned that the grub bored one-quarter inch holes in Fir trees (which is only too correct a description), and was destroying much valuable timber on his property. He also observed, "Neither I or any person about here have ever seen them before, and if they increase in number will destroy all the timber about here."

From the great size and conspicuous yellow and black colouring of the female (figured life size at p. 122), it could hardly have failed to attract attention if at all numerous; and it would be of interest, both practically and as matter for record, to find whether the attack spreads onwards from the coast.

The history of the method of attack has been given in detail in previous reports. This may be shortly stated to be that the female bores a hole through the bark of various kinds of Fir trees, with her strong ovipositor or egg-laying apparatus, for the deposit of her eggs. This apparatus, see figure at p. 122, is a long fine process appended beneath the abdomen; the abdomen itself ends in a strong blunt point. The maggots are whitish and fleshy, and with their strong jaws eat their way onwards in the solid deal or Fir timber, causing thereby such galleries as quite to ruin it for working purposes. They are said to be full grown in about seven weeks. The change to chrysalis and complete state takes place within the tree, but though the "Wood Wasp" may be fully developed and come out in a month from the change to the chrysalis state, this may very possibly not occur until the following summer, or may be still further delayed as in many other cases of wood attack.

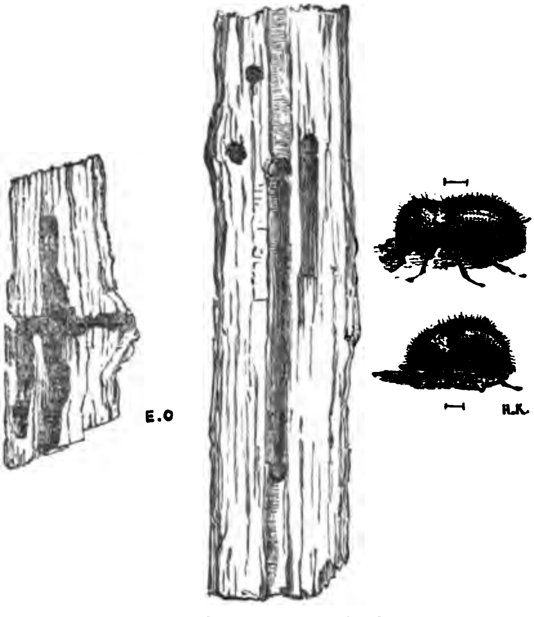
The infestation has been considered chiefly to affect trees in which the sap is not in full flow either from age, or from accidents to the branches or other part attacked, or especially to affect felled or fallen timber or branches.

Where the insects, as is sometimes the case, are seen coming out in numbers in the course of a few hours from a felled trunk, it is well worth while to set some one with a hand net to catch such as may endeavour to fly away, or to destroy them as they make their appearance.

Splitting up felled timber known to be infested, and using it for firewood or otherwise, so as to prevent any chance of insects spreading from it, and similar attention to injured or fallen trees or branches in Fir woods, are the best (and apparently the only) methods which lie in our power of checking spread of this attack. This infestation appears to merit attention, for it is being increasingly reported. In 1850 (as quoted p. 122) it was considered as of rare occurrence, and it has gradually been more observable, until, as at present or in the last few years, I have notes and specimens of infestation, of both *S. gigas* and *S. juvencus* (the Steel Blue Sirex), occurring in standing timber to an extent to cause definitely calculable loss.

PLUM.

"Shot Borer." "Apple-bark Beetle." "Pear Blight." *Xyleborus dispar*, Fab.; *Bostrichus dispar*, Fab.; *Xyleborus pyri*, Peck (of American writers).



Xyleborus dispar: Male and female beetle, magnified; lines showing nat. length. Plum stems, showing horizontal and perpendicular galleries.

It will be remembered that in 1889 a small dark brown beetle (figured magnified above with the natural length marked accompanying), which had previously been considered to be one of our rarest kinds, made its appearance in stems of Plums at the Toddington Fruit Grounds, and a few other localities not far off, in such numbers as to cause considerable injury.

The mischief is caused by the beetles so tunnelling the trees as to stop the course of the sap; and consequently the destruction of the small trees (which are preferred for boring purposes by the beetle) is rapid and complete. Full details were given in my preceding Report.

But it may be desirable to repeat that the reason of the singularly rapid and complete destruction of the stem of *young* trees attacked by these beetles was plainly shown on laying open their tunnels. In the specimens of these from Toddington which I examined (figured life size at p. 124), I found that the injury began by a small hole like a shot-hole being bored in the side of the attacked stem, from which a tunnel ran to the pith, and a branch about the eighth of an inch across ran horizontally about half or two-thirds round the stem. Sometimes this tunnel was about midway between the outside and the centre, but in one instance quite at the outside of the wood. From these horizontal borings, other borings were taken straight up and down the stem; these might be certainly as many as four (perhaps more in one stem), and were from half an inch to upwards of an inch and a half long; and of these tunnels (in the pieces of stem I examined) one ran along the pith, which was completely cleared away. The great injury caused by these galleries fully accounted for the death of the stem.

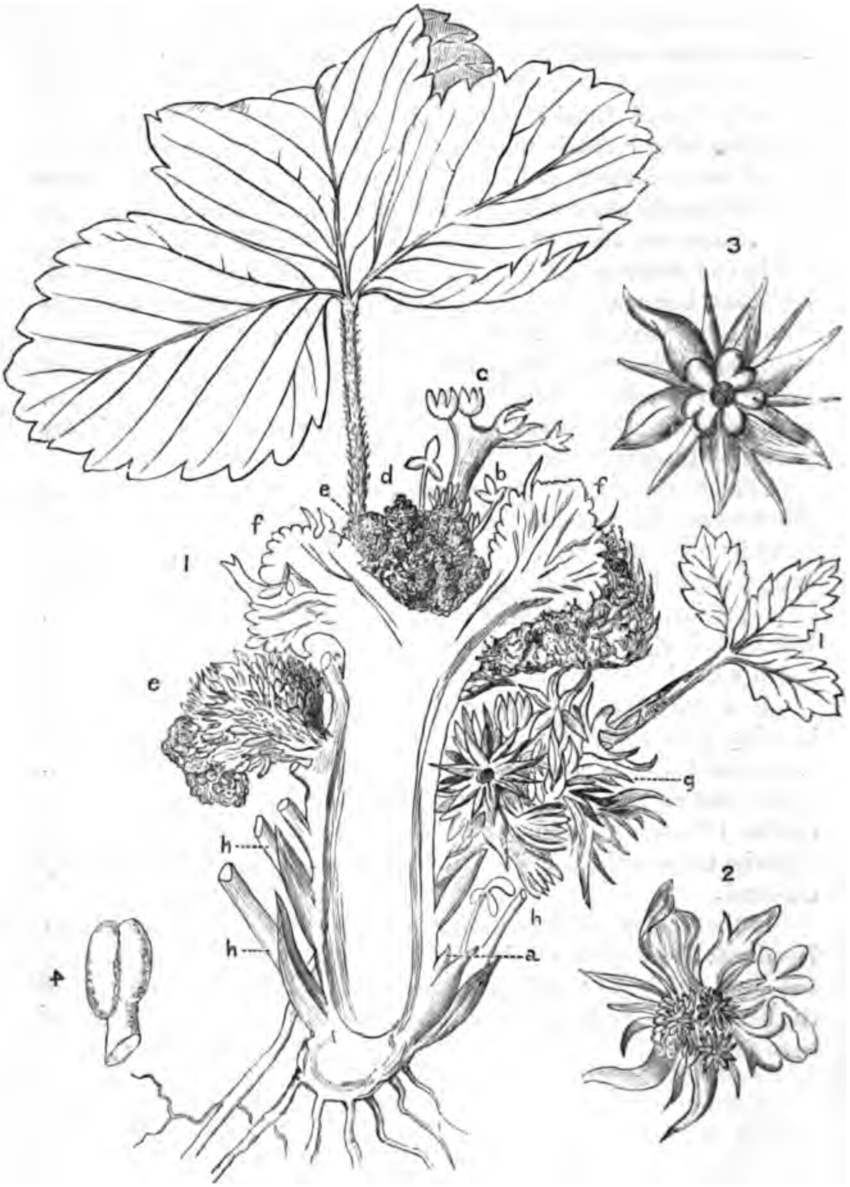
The great peculiarity of these insects is the difference in shape and size between the male and female (the *disparity*, from which the beetle takes its name of *dispar*). The female is about the eighth of an inch long, narrow and cylindrical, with the thorax (the fore body) large in proportion, and raised in the middle so as to make a kind of hump. The male is only about two-thirds of the length of the female, and much wider in proportion, and the back is flatter.

As a method of prevention, cutting down the attacked trees and burning them when the infestation is noticeable is most strongly to be recommended. It is no waste, for in many cases the attack is completely and rapidly fatal, and if the plan is carried out before the female beetles (which may be found in such numbers as almost to fill the galleries towards the end of summer or autumn) have flown, it is very effectual.

In the case of the attack of this *Xyleborus dispar*, or Shot Borer Beetle, at Toddington, all the trees that were found to be affected were cut down and burnt; and this year Mr. C. D. Wise, the manager of the Toddington Fruit Grounds, notes that only one case of attack has been found.

STRAWBERRY.

"Cauliflower Disease." *Aphelenchus fragariæ*, Ritz. Bos.



Strawberry plant diseased by infestation of *Aphelenchus fragariæ*, after drawing by Dr. J. Ritzema Bos.

DESCRIPTION OF FIGURES.

1. Strawberry plant infested by *Aphelenchus fragariæ.*
    - *a.* Scaly buds developed in the axils of normally developed leaves—*h.*
    - *b.* A very swollen stem, with
    - *c.* Rudimentary flower buds always remaining closed.
    - *d.* Accumulation of rudimentary buds at the base of the branch *b.*
    - *e.* Cauliflower-like accumulation of strongly branched and broadened inflorescent parts, with imperfectly developed flowers and sheathing-leaves.
    - *f.* Section of similar Cauliflower growth.
    - *g.* Accumulated blossoms, partly rudimentary, partly abnormally, developed, such as are shown separately in 2 and 3.
    - *h.* Portion of leaf stalks of normally developed leaves.
    - *i.* Stunted leaves of fairly normal shape.
2. Monstrously developed blossom; outer leaves of the calyx narrow; inner calyx leaves more developed, some very thick and twisted, others branched, and a few trifid like ordinary leaves; the blossom appears to have split into three divisions, but the petals, stamens, and pistil of these parts have remained rudimentary and indistinguishable from each other.
3. Monstrously developed blossom; outer leaves of the calyx narrow; inner leaves of calyx well-developed, but a few of them twisted; petals of corolla stunted, and some of them twisted, and no sign of pistil or stamens.
4. Abnormally developed stamen.

The figures opposite, are copied, by permission of Dr. J. Ritzema Bos, from a portion of the illustrations given in his paper on "The Cauliflower Disease of the Strawberry, caused by *Aphelenchus fragariæ*, nov. spec.," entitled "De Bloemkoolziekte der Aardbeien, veroorzaakt door *Aphelenchus fragariæ*, nov. spec.," door J. Ritzema Bos (voorloopige mededeling). Overgedruckt uit het Maanblad voor Natuurwefenschappen, No. 7, Jaargang, 1889.

In availing myself of the courteous permission of Dr. Ritzema Bos to extract from his pamphlet, it is but right to mention that with the accompanying figures I have only inserted a portion of the elaborate numberings and details given in the original paper. As my report is for general use, these minutely scientific details would be out of place here; but in extracting from his work I am bound to mention the elaborate minuteness of the paper from which I give some main points.

The following observations refer to peculiar malformations of growth, caused by Eelworm presence, so affecting the stems and infloresoence of the Strawberry plant as quite to change the characteristic appearance of the growing portions of the plant, when it should be running on into flower, and ruining it for all useful purposes.

From the buds (or the various portions which should have formed the buds and flowering stems) being so greatly swelled at the extremities, and also so shortened and pressed together as to resemble nothing so much as pieces of Cauliflower placed amongst the deformed stems, it has seemed convenient to give the name of the "Cauliflower disease" to this form of Strawberry attack, in the same way that "Tulip-root," "Pine Apple disease," or other names describing the shape of diseased growth, are given to the malformations caused by the presence of the minute nematoid worms, popularly known as Eelworms, in Oat plants, Carnations, and other garden or crop plants.

The first observations of this very peculiar attack which I received, were sent me by Mr. Thos. May, of St. Paul's Cray, Kent, on the 23rd of May, and were as follows:—"I have forwarded you to-day a hat-box containing specimens of Strawberry plants from a field of 14 acres; nearly half the plants have gone like these specimens. Will you please say whether caused by an insect or grub injuring the crown just above the roots" . . . . "Whether there is a remedy or prevention, and whether the plants will recover, as some seem likely to do, for another year?"

These plants were greatly deformed, and I found Eelworms therein. On the 28th of May a further supply of diseased Strawberry plants were sent me, in which I found Eelworms in exceedingly active condition, numerously present where I examined, and (together with the specimens) I received from Mr. Thos. May some further observations as to loss being serious, and likewise as to previous succession of crops, as follows:—"I trust you will be able to ascertain the cause, as it will be a serious loss to me this year in the 14-acre field. Now, in reply to your questions, the field has been cropped as follows:—

	"CROP.	MANURE.
1881 to 1884.	Strawberries	
1885.	Potatoes	Heavily manured with London straw dung, and some kainite suppl. ammonia, superphosphate, sown with Potatoes.
1886.	Wheat	
1887.	Clover, very heavy crop	
1888.	Potatoes	Heavily manured (again as before) in winter of 1887-8.
1889.	Planted Strawberries and plants, all started well and did well.	1889-90. Manured Strawberries in November and December, and *dug in* peat Moss and sawdust horse manure from London, having laid in lumps from August."
1890.	Strawberries with large quantity of deformed plants.	

On June 3rd, together with further specimens of Strawberry plants from the same 14-acre field, Mr. May mentioned that half of the plants were affected *equally all over the field*, excepting on a half-acre, where there were Potato clamps before planting, and where they had a large manure-mixen. "These two patches," my correspondent wrote, "look well, all but an odd plant or two here and there, about one in fifty in these two patches; the remainder of the field is just about equal. The plants on half the field came from my own old plants, and the other half from a neighbour's." With regard to the origin of the infestation, Mr. May observed, "I am satisfied it has nothing to do with the plants when put in; they all grew well last season."

In the first specimens of diseased Strawberry plants sent me I found some Eelworms, and in a further supply sent me on the 28th of May, on opening one of the side buds and tearing it small under water, I at once found Eelworms of various sizes numerously present; these Nematodes appeared to me to be longer in proportion to their width than is the case with the *Tylenchus devastatrix*, which infests so many of our plants or crops, notably Oats and Clover. Not, however, having the requisite knowledge of nematoid worms to identify the species trustworthily, I forwarded infested plants to Dr. J. Ritzema Bos, Professor at the State Agricultural College, Wageningen, Netherlands, for the benefit of his well-qualified opinion. On examination Dr. Ritzema Bos found the infesting Eelworms to belong to the genus *Aphelenchus* of Bastian, but not to be identical with any of the species of this genus with which we were previously acquainted, and therefore, as being previously undescribed, he has bestowed the name on it (in his "Preliminary Paper" descriptive of the Nematode and its attacks) of the *Aphelenchus fragariæ*.

The much magnified figures of *Tylenchus devastatrix*, on the plate facing p. 48, may be taken as giving a general idea of the shape of *Aphelenchi*, inasmuch as in both cases these are "long eel-shaped *Anguillulidæ* with a flexible ringed skin"; in both cases also there is a "spear" or "stilet" in the mouth-cavity or gullet. There are, however, essential differences in structure, which, as they can only be observed with the help of very high microscopic powers, I do not enter on here, but by permission of Dr. Ritzema Bos, who is good enough to allow me to extract at pleasure from his paper, of which the title is given at page 127, I offer just a few notes from his measurements, &c., and likewise his valuable botanical description of the effect of the infestation on the plant growth, as giving this with a technical precision beyond my own powers. I have also added from the plate of *A. fragariæ* and the malformed growths caused by it, given in his pamphlet, a portion of the figure of the different forms of injury the infestation causes to different portions of the plant, drawn by him from life.

Dr. Ritzema Bos observes that "this *Aphelenchus fragariæ* is a small species" (the greatest length of such small amount of males and females as occurred in the plants I sent was found by him to be, of males, 0·85 mm.; of females, 0·80 mm.—Ed.). "The stilet is small; in one specimen I decided it to be 0·0094 mm. long. Although this organ is at first sharp and thin, it ends in a blunt knob-shaped swelling.* The gullet was indistinct in the specimens I examined; it seemed to be rather twisted. The sucking stomach is oval; there the intestine begins, at first very narrow, afterwards broader. Its wall is finely granulated." Details are given of male and female characteristics, so far as observable; but though larvæ were plentiful in the plants I forwarded in May and June, yet Dr. Ritzema Bos noted with regard to the males and females:—"I did not observe one of either sex which was perfectly mature, containing developed spermatozoa or eggs on the point of being laid. It seems from this as though reproduction only takes place during the latter part of summer."—(J. R. B.)

The following extract describes the effect of the infestation on various parts of the plant, as the stems, buds, flower petals, calyx, &c., and being favoured with permission so to do, I give it in the words of Dr. Ritzema Bos rather than my own, as being clearer and much more technically precise than any wording I could myself have offered.

Description of the effects of the infestation on the growth of the Strawberry plant.

"In the axils of the normally developed lower leaves (see Plate, fig. 1, *h*) numerous thick scaly buds appear, much like the little scales that form on a bulb; these buds never grow new stolons. Sometimes the main stem grows fairly tall to begin with (probably because the plant was not attacked by a large number of *Aphelenchus* at once), but a certain height being attained, it branches very vigorously, and the branches are not only thick and broad, but remain united as they grow, so that there is actual fasciation. There is, however, no ribbon-like broadening, but a thickening, which can be best compared to a piece of Cauliflower; therefore I have indicated the disease caused by *Aphelenchus fragariæ* as 'Cauliflower disease of Strawberry plants.'

"In a few cases a simple ribbon-like broadening of the stalk takes place, and the numerous flower and leaf buds that result are more or less normally developed. Sometimes one side of the stalk or branch grows and fasciates more strongly than the other side; the stem then bends, and may even become quite twisted up. Some stems split at the top of the fasciation into a number of different branches, with more or less normal flowers and leaves. Most commonly, however, the stalk or branch gets scarcely broader, but much thicker; the side branches remain in great part fixed together, and it is an exception for the buds to be perfectly developed. The deformed plant greatly resembles Cauliflower or Brocoli, according as the different parts are more or less enlarged and attacked, and according as the buds are not at all or only partially developed, or have produced malformed flowers. Some very broad and stunted stalks have buds on the top, pressed together like a cock's comb; and some have them at the sides, spread very irregularly, in consequence of the irregular growth, but growing thickly squeezed together over a large surface.

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* If the reader will turn to Plate of *T. devastatrix*, he will see a spear or stilet with knob-shaped base figured at "*a*" in 1 and 4, which gives an idea of the form of this mouth part, but with the difference that in the *Tylenchus* this knob is trilobed.

"Usually, as in Cauliflower, one finds buds almost all over the squeezed-up mass of malformed parts. The likeness to Cauliflower is especially strong, as is shown at *e*, fig. 1, of accompanying Plate. Similar Cauliflower-like parts are shown, in section, at *f*.[*]

"If all the branches of the abnormally branched parts remain short and pressed close together, they take the appearance of common Cauliflower; but if the flowering stems get more slender, and are not joined together all the way up, then the likeness to Brocoli[†] becomes strong. The branches are generally all more or less enlarged (fig. 1, *b*), though a few of them may develop normally; some of the leaves may be normal, but many remain very small, and the leaf smaller in proportion than the stem; sometimes instead of being trifid it is entire, and some are much twisted.

"The sheathing leaves are mostly small, or thick and irregularly twisted. The flower buds are sometimes very thick, while the leafy parts remain thin and scaly; sometimes the leafy parts become much thicker, but remain short, and continue to produce little scales. Often the outer calyx, and calyx, are more developed than the other leafy parts. Sometimes the bud remains entirely or in part closed (*c*), while the outer calyx, and calyx, go on developing normally; but often the flower bud opens.

"The leaves of calyx and outer calyx are frequently abnormal, those of the outer calyx being very thin and narrow, almost needle-shaped; while the calyx leaves, on the contrary, develop more strongly; occasionally they are twisted, and have bubble-like swellings on the under-side. Some are more or less cut into; others are trifid, imitating the normal leaf (see calyx leaves, figs. 2 & 3). The corona petals sometimes do not develop at all; often they remain rudimentary; sometimes (fig. 3) they are much smaller than the divisions of the calyx, and twist to and fro, generally towards the inside; then they are not white, but greenish white or very light green, though thin and delicate in texture as usual.

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[*] 'On the Structure of the Cauliflower.' Compare Samsœ Lund, 'Hjalmar Kjaerskou Morphologisk-anatomisk Beskrivebse': *Brassica oleracea*, L., *Brassica campestris*, L., and *Brassica napus*, L. (Havekaal, Rybs or Raps), Copenhagen, 1885, pp. 52—54. See also the figures in same work, Plate 10, and compare with fig. 1 of my Plate, *e* and *f*. Compare also the illustrations in [*]'Om Landbrugets Kulturplanter og dertil horende froavl.' No. 4. Beretning om virksomheden i. aarene 1882—3, ved. E. Rostrup, Copenhagen, 1884.

[†] Especially to the Brocoli described in note (1) of the latter work, p. 151, fig. 52.

[*] 'Our Cultivated Plants and their Diseases' (Danish).

"The stamens are wanting in many of the flowers, or are represented by such rudimentary growths that their real nature cannot be recognised; in others, which have a normal anther, the filament is much thicker and shorter than in the case of normal stamens. The receptacle and pistil are often very small (fig. 3); sometimes the latter is altogether absent. Sometimes there is an axillary prolificacy of bloom; this always seems to be caused by new buds forming in the axils of some of the calyx leaves.* But these buds never make normal flowers (fig. 2); in the place of where they might have been we find a number of leafy organs, nearly rudimentary, sometimes forming little knobs.†

"It is hardly necessary to add that stems, leaves, and blossoms of fairly normal development may be found on plants that are only slightly attacked by the disease."

In the foregoing extracts I have availed myself gratefully of the permission of Dr. Ritzema Bos to make use of the descriptions given in his paper, as, indeed, without so doing I could only have laid an excessively meagre account before the reader, without details of the nematoid cause of the infestation. But, whilst limiting myself to such extracts as may be of general interest, I should be to blame in not mentioning that these give no idea of the minutely detailed observations given by the author, nor of the amount of valuable information contained in his note-references to published works where descriptions of the various species of *Aphelenchus* already recorded may be found, and other points of scientific interest. The paper is headed as a "preliminary" one by the author, as he desires to add further points from the coming season's observations.

We are still without knowledge as to where the infestation came from, and also we do not know what remedial applications may be of service in checking the diseased growths, because these were already fully developed when the attack was first brought under my notice towards the end of May, 1889. Then it appeared to me that as the plants sent were masses of infested malformed growth, the best suggestion I could give was to destroy them as rapidly and as thoroughly as could be done, so as (if possible) to stamp out the Eelworm presence.

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* "According to Maxwell T. Masters ('Teratology of Plants,' translated into German by Udo Dammer, Leipzig, 1886), new buds are formed in the axils of calyx leaves more frequently than in those of the other leafy organs of the flower."

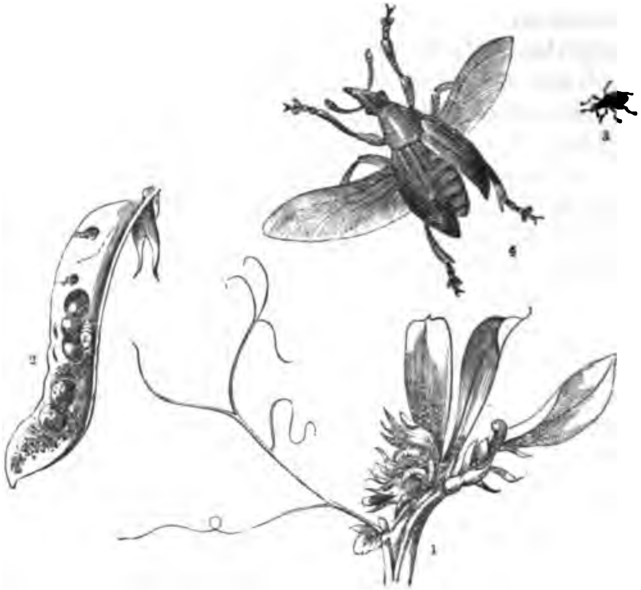
† In the original paper many references are given.

The only clue that, so far as I see, we have at present, towards checking this special form of attack, lies in the circumstance of scarcely any of it (perhaps one plant in fifty) being observed on the spots where, respectively, a manure heap and also Potato clamps, occupying about half an acre, had been. These spots were dressed with the same peat-moss, &c., manure, and in the same proportion as the rest of the field; so this shuts the door on the probability of the infestation being brought in the manure, which suggested itself. But it certainly points to difference in state of surface soil affecting amount of attack. Whether the plants throve and did better on these spots, and so resisted attack better, or whether the Eelworms which might be present were buried and killed, is at present unknown; but still we may get some practical help towards prevention from the above observation.

With the coming season it will be possible to try, with the first plant growth, whether the applications of sulphate of ammonia, sulphate of potash, &c., mentioned at p. 20, which have been found serviceable in other cases of Eelworm attack to other kinds of plants, may not be serviceable in this case also.

TARES.

Tare Weevil. *Apion pomonæ*, Fab.



1, Distorted flower head of *V. sativa* infested by the "Weevil"; 2, seed pod showing injuries inflicted by it; 3 and 4, "Weevil," *A. pomonæ*, nat. size and magnified.

On the 15th of July in the past season the following communication was sent to me, with specimens of the infestation accompanying, by Mr. A. Hamlin, of Chellowes Park, Lingfield, Surrey:—"I herewith forward you a few heads of Tares, infested with maggot, taken from an eight-acre piece, the whole of which is equally bad. As this is a very common pest in this neighbourhood, recurring rather frequently, I thought perhaps you might know its natural history, and probably be in a position to recommend a remedy, so that we might endeavour to lessen or exterminate it."

The heads of the Tares were variously affected by the attack. In some instances a portion of the blossoms had expanded, or were expanding, apparently quite rightly, but just beyond them the buds were stunted so as to form nothing but a terminal deformed bunch composed of stunted calyces, with sometimes minute embryos of flower and ovary within, sometimes some minute stunted leaves mixed with them. These deformed flowers varied very much in size, and whereas the calyces of the healthy blossoms were over half an inch in length, those forming the diseased bunches were often from about a quarter down to only about an eighth of an inch in length.

In some instances these masses were chiefly green, but often they were brown, and injured towards the middle of the bunch. Each individual floret (or rather what would have been the floret, if it had not been attacked) was usually swelled at the base into a shape like a little bulb, with the calyx tips surmounting it like minute feathers.

Besides the injury to the buds, I found much deformity caused to the leaves. The lower part of the leaf stalk was greatly swelled (to five or six times its natural width), and, instead of standing out at an acute angle from the stem, was often curved backwards, so as partly to encircle it, or turned downwards. The leaflets were sometimes merely placed somewhat nearer together than was natural, sometimes so closely that the two sides of each leaflet were pressed together, and against those on each side along the leaf stem, like the flattened fingers of a glove. The heads were also somewhat turned down, and when the leaf stems near were also swelled, the deformed condition was very noticeable.

The magnified figure, at p. 187, of one of the diseased heads shows the stunted florets massed together, with a number of the partially unfolded leaflets pressed almost against each other, and growing from a much swelled and distorted leaf stalk. I had not, however, the opportunity of making out with any degree of certainty the kind of insect which caused the attack. So far as I can make out by insect presence, or by description, it *might* be caused by a *Cecidomyia*, or by the *Apion pomonæ*, one of the Clover weevils, or by both. If any reader, either from personal observation or from better entomological knowledge, should have traced the attack to its cause, it would be of very serviceable interest if he would be good enough to let us know.

In the heads of Tares sent me on the 15th of July, and somewhat later on, I found larvæ of some kind of *Cecidomyia*, or Gnat Midge (little maggots resembling the well-known Red Maggot of Wheat in shape and size), with the anchor process very plainly to be seen under a one-inch object glass. The largest specimens were of a rather pale orange colour, the smallest, up to about half-grown, white or whitish. The "anchor process," that is, the kind of horny scraper lying beneath the body at the head end, was distinctly bifid at the free extremity, though not so deeply cut in as in that of the *Cecidomyia leguminicola* (the American Clover-seed Midge), figured at p. 23. The position of the scraper will be seen from the "Red Maggot," figured at 2 on the same page. The maggots were somewhat numerous* in the heads first examined. Later on, that is, on the 28th of July, Mr. Hamlin wrote:—"It may be of interest to you to know that I had considerable difficulty in finding heads containing the maggots to send you on the second occasion, though the first time I sent them, which was but a few days previously, I had about an equal difficulty to find them free." This observation points to the maggots going down into the earth for their changes; and also, Mr. Hamlin observed, when some of the Tare heads were laid on earth, that these (and other maggots from the heads) went down into the soil. Mr. Hamlin also remarked "that the infestation started from the hedgerows."

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* There were also some Thrips present, almost entirely of a bright yellow colour, excepting towards the extremity of the tail, which was black.

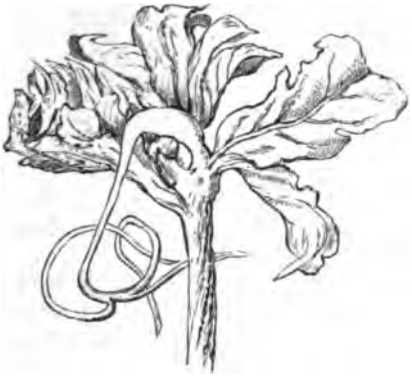
In Curtis' 'Farm Insects,' at p. 487, the author observes, under the head of Tares:—"In July the flower heads are often distinctly distorted, and on opening them numbers of maggots are found concealed in and amongst the calyces, or cups of the flowers, where they eat into the base, and entirely consume the incipient pod. These little larvæ are 1 line long, of an orange colour, tapering to the head, and blunt at the tail. In all probability they are the offspring of some species of *Cecidomyia* allied to the Wheat Midge."

Turning now to the short notes given by Bergenstamm and Paul Löw of various species of *Cecidomyiæ* of which the method of life of the larvæ is known, but of which the perfect insects (up to date of publication) were still unknown and undescribed, I find four kinds recorded as (respectively) causing deformed growth of the inflorescence, the leaves, or the shoots of various species of Vetch, one of these being the *Vicia sativa*, the Tare. Of one kind it is noted (No. 597, p. 98), "The larvæ live in deformed blossoms of *Vicia sativa* and *cracca*, L.," and the suggestion is added that perhaps it is identical with the *Diplosis loti*, Deg. As neither Mr. Hamlin nor myself succeeded in rearing the perfect Gnat Midge from our *Cecidomyia* maggots, we cannot at present form any opinion as to the species of these larvæ.

The above infestation may prove (when we can procure full details) to be the cause of part of the mischief; but there was another kind reported to be sometimes present, which probably had to do with the matter, thus noticed by Mr. Hamlin:—"We are also troubled occasionally with a maggot that is found in the Tare pods, which develops into what we term 'a bug' with wings, having a sharp snout 'similar to a mole.'" This short description corresponds, so far as it goes, with that given by Curtis of the attack of the *Apion pomonæ*, one of the long-snouted weevils, figured at p. 184.

Of this John Curtis says that at "the end of July, 1847, I found in a field of Tares or Vetches (*Vicia sativa*), left for seed and partly ripe, a great number of the pods, which were more or less distorted. On opening them I found the seeds partially eaten, some with only a hole in them, surrounded by abundance of brown and white excrement; other seeds were hollowed out, and a cell formed in each of them of an oval form, but irregular; in these cells was either a fat maggot or a pale ochreous pupa, which I at once saw was that of some weevil. On the 16th of August three specimens of *Apion pomonæ* hatched." These were at first of an ochreous colour, but eventually became black.*

These beetles are partly distinguishable from most of the other of our Apions by the peculiar shape of the proboscis, which is short, and thickened at the base; in fact, as Mr. Hamlin describes above, "a sharp snout similar to that of a mole." The figure on p. 184 conveys this and the projection of the eyes very fairly. The colour of both male and female black; length variable, sometimes nearly a quarter of an inch. The beetles fly readily, and especially frequent Whitethorn; also hedges, which agrees with Mr. Hamlin's observation that the infestation started from the hedgerows.



Deformed flower head of Tare, magnified. Drawn from specimens sent by Mr. Hamlin.

If the reader will compare John Curtis' figure, given at heading, of a Tare blossom head distorted by this infestation, and the figure drawn by myself from life, given above, he will see a remarkable similarity in method of attack; but still I do not find notes in any work I have at hand of this *Apion* infestation distorting the leaf stalk, which, as I have shown in my figure, was a noticeable point in the Lingfield specimens sent me. As this Tare attack is a very troublesome one, I have given all bearing on the subject which I have access to, though by no means thoroughly clearing up the matter, and shall be very glad of fuller information.

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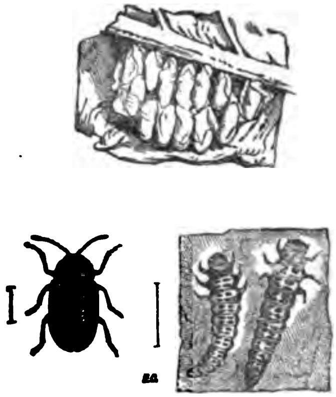
* 'Farm Insects,' by John Curtis, p. 488.

WILLOW.

Willow Beetle. *Phratora vitellinæ*, Linn.



PHRATORA VITELLINÆ.
Willow Beetle, caterpillars, and eggs, magnified; lines showing nat. length.

Willow Beetle attack was excessively injurious in the past season at various localities. About the middle of May I received the following account of the great damage that was being caused in their plantations by this infestation, from Messrs. W. T. Ellmore & Son, High Street, Leicester:—"We have a piece of Willow ground some 50 acres in extent, which is literally infested with them, to the detriment of the crop. Acres and acres of the crop were last year virtually destroyed with this pest, and we employed quite a small *host* of people with tins with paraffin in to catch them, and we were hoping that our efforts would have been rewarded by their absence this spring. In addition to what we caught last spring, in the autumn we put faggots all about our ground, made with reed and other tubular plants, pieces of bark and other rubbish, which were instrumental in collecting very many, and these we fired in the early months of the year; but during these last few days the beetles have come out almost in millions. We have now as many caught as will fill a good-sized bucket, by which you can judge how we are infested."

On June 10th, Mr. John Harrison, President of the Leicestershire Chamber of Agriculture, also notified to me that "we have now a trouble amongst the Willows, a large grower in this locality having suffered greatly."

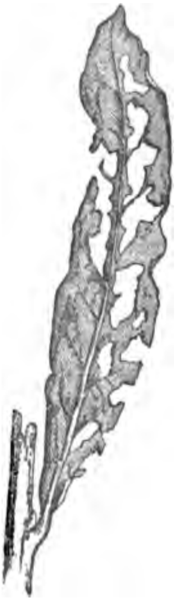
On Aug. 24th, Mr. Weld Blundell, of Ince Blundell Hall, Blundellsands, Lancashire, enquired regarding a Willow Beetle which had destroyed all the Willows on his estate. Later on, on Oct. 26th, application was made me by Mr. J. Mc'Kenzie, from the Inspector and Surveyor's Dept. of the Rural Sanitary Authority, Altrincham, Cheshire, regarding information to check, if possible, a serious blight which had visited Willows growing on one of their sewage farms.

The specimens forwarded showed the cause of mischief to be the Willow Beetle, and the following observations were sent:—"The crop of Willows (one year's growth) now growing on our Ashton-on-Mersey Willow Beds have been blighted with some sort of insect or fly, the whole crop turning quite yellow in the leaf in a very short space of time. It seemed to take whole of outer edge of crop first, and then travel inwards. The leaves turned yellow in the leaf and then dropped, and on examination we find the bark has even been eaten. All the Willows in the surrounding hedges and ditches are similarly affected. Willows growing on the Stretford Sewage Farm (2 miles away) were also affected, but one day they swarmed and went away in clouds, and have not since returned."—(J. Mc. D. Mc'Kenzie.)

On the 20th of Oct., the following note was sent, accompanied by specimens of injured shoots from Mr. J. M. Wilson, of Carrygrane, Edgeworthstown (Leinster, Ireland):—"The enclosed are some pieces of osiers, taken promiscuously from a large bed which I have, and which this year has failed entirely. Perhaps you can inform me what is the cause?" This also, though beetles were not sent, appeared from the method, and also from the severe amount of injury to leafage, to be another case of damage from infestation of the Willow Beetle, the *Phratora vitellinæ*.

These beetles are of the shape figured at p. 138, with the natural length given by line accompanying, of a shiny greenish or bluish or bronze tint above, more brassy below. They shelter during winter in any convenient place, as under old bark of Willow or other trees, in rubbish on Willow grounds, in crevices of fences, &c.

From these they come out in spring, and begin the first attack somewhere about May. They lay their eggs on the surface of the leaf, and the pale black-spotted grubs which hatch from these feed on the under side of the leafage, working right through until the upper film becomes so thin that it cracks or dries away, leaving the leaf in holes as figured.



Willow leaf partly eaten by Willow Beetle.

This makes the second attack. Later on these maggots turn to chrysalids *in the* ground, from which the autumn brood of beetles comes up. These attack the leaves and young shoots, and do immense mischief. Thus there are three definite attacks—that of the great mass of the summer or autumn beetles, which appear when the Willow growth is well advanced; another of these beetles, which come out again to forage on the new growths of Willow, after their own winter sleep; and the ravages of the grubs in the summer.

PREVENTION AND REMEDIES. — The preventive measures, as is obvious, lie in removing, so far as can be done, all winter shelters where the beetles could resort to for protection. This must make some difference; and also *abstaining* from making large collections of rubbish, as of Willow peelings, &c., and leaving them to decay, or using them (as I have seen done in the case of the peelings) to form a kind of rough thatch to sheds, must certainly prevent the attack being as bad as it would otherwise have been. But these measures have proved, as we know, very insufficient.

We are in the same position here regarding plant growth that we are in regarding orchard growth in fruit farming. We have large areas—a good many acres, that is to say—of plant crop growing on, year after year, on the same ground. Direct remedy—something to be applied to get rid of the infestation (if it be possible) when it appears—is what we want.

In a very bad attack, in 1884, to Willow beds at Lymm, Warrington, and other places on the border of Lancashire and Cheshire, regarding which I had much correspondence, Mr. Cameron, writing from Lymm on the 29th of May, reported as follows:—"The remedies hitherto tried (but so far with little success) are dusting the young shoots with hellebore powder, soot, sulphur, lime, and spent gas-lime. *The plan now adopted is to hand-pick, or rather shake off, the insects into small vessels containing a small quantity of paraffin oil.* This plan has been steadily carried on by many of the Willow growers during the last fortnight *with marked success;* but unfortunately a few people take little or no notice, and I fear these neglected lots will pollute the surroundings."

In the past season of 1890, Messrs. Ellmore, writing to me on the 29th of May, further confirmed the above report by mentioning as follows:—"We have frequently been in communication with an old friend of ours, Mr. Hutchinson, of Warrington, who is an important Willow worker and grower." He said that "his experience led him to think the best remedy was in picking them off by hand, and placing in tins containing a small quantity of paraffin. That is the course we have pursued, and fifteen men have been employed doing this, and have caught endless quantities. In fact, we have caught as many beetles as would fill a fair-sized bucket."

In the experiments undertaken at my suggestion in 1884, we found that Paris-green gave some good results, and I should certainly think that, with the great increase in knowledge that we have since then of *how* to apply this chemical, of the proportions in which it is to be used for delicate leafage, how to mix it with flour, and, further, the feasibility of obtaining conveniently portable knapsack sprayers with nozzles which will distribute the fluid properly in the form of fine spray, this remedy would be very likely indeed to be of service.

Looking at notes of success and also of difficulties to be met in 1884, I find that Mr. G. H. Leigh, a Willow grower at Lymm, mentioned that, having tried the application of soot and also of hellebore without any success, he then tried Paris-green, with about half an ounce to three to four gallons of water. The Willows by this time were grown three feet high; therefore he could not apply a good spray; but the application to the plants on the compass of ground sprayed with Paris-green *was successful.* It scorched the leaves a *little*, and made them curl, which he believed was the cause of the beetle removing itself; but "it did not injure the main shoot." Also, it is noted, "I cannot say it killed the beetle right out, as it immediately dropped to the ground, being always on the alert when anything touched the leaves."

Mr. Leigh added:—"I am also of opinion that Paris-green, if used early, would prevent, if not completely destroy, them; and if it was more used with a good spray it would destroy it in the early stage."

At the conclusion of the reports of the summer the Paris-green had been most satisfactory of all the dressings which had been tried, and Mr. Cameron remarked:—"Indeed, I *believe by applying this dressing* early enough the beetle might be kept fairly well under, the difficulty at this season of the year being to get the wash distributed; the Willows grow so thickly on the ground, and so high, that any spray distributed cannot be used."

The different points were given in detail in my Report on Injurious Insects of 1884, published in 1885; but if the reader will just look over the notes given above, in the light thrown by the experiments of our Evesham Fruit Conference Committee during 1890, it will be seen that the difficulties we met with in 1884 can be coped with now.

The proportion mentioned above is ½ oz. of Paris-green to three or four gallons of water. This is stronger than what we advise. 1 oz. of Paris-green to ten gallons of water for Plum leafage, and 1 oz. to twenty gallons of water for Apple leafage, is the strongest proportion that we recommend.

With regard to killing the beetle. — The application does not kill by contact, but by poisoning the food. Therefore the application should on *no account* whatever be sent vigorously, like a rain-storm (as I have reason to believe has sometimes been done), at the infested plants, for in this case it only knocks or frightens the beetle out of the way of what is meant gradually to kill it. It should be sent as a spray, to rest like a dew evenly all over the surfaces of the leafage, so that, unless the beetle flies elsewhere, it has no resource but to eat the poisoned food; and if the spraying is as complete as it should be, the dew will rest on the under as well as the upper surface of the leaves, and avail in destroying the grubs as well as the beetles.

Another point mentioned as a difficulty was "the Willows by this time were grown three feet high; therefore he could not apply a good spray; but the application to the plants on the compass of ground sprayed with Paris-green was successful."

By means of the knapsack sprayer, which was successfully used at the Toddington Fruit Ground last year, the spray can be sent to a height of fourteen or fifteen feet, and properly distributed."*

So far as the more practical work of application of the Paris-green is concerned, it will be seen that the above notes of advance in information, since our experiments of 1884 were tried, will meet the difficulties which then encumbered us. Looking at the amount of success which we then had, and also considering that Paris-green is *the* especially approved application in America, and has been so for many years, and over thousands of miles, for keeping down the Colorado Potato Beetle (which, being one of the *Chrysomelidæ*, is very nearly allied to our Willow Beetle),—these points appear to suggest forcibly that it would be well worth while to try again, with the lesser strength and the better spraying machines, whether we could not get rid of the Willow pest when it appears.

All the requisite *cautions* to be considered in the use of Paris-green, it being arsenite of copper and consequently a poison, and all requisite instructions as to methods of use, are given in the preceding pages, under the head of Paris-green; also notes of another arsenical insecticide, "arsenite of lime," sold under the name of London-purple, in the use of which similar *precautions* and methods of application are to be observed. It should, however, be always borne in mind that for safety to leafage, in the case of insecticides of which the effect is not wholly known to the applier, experiment should be made on a small scale to a few trees or plants, and the results watched for a few days, and their effect ascertained beyond all doubt, before proceeding to try them on a scale that may at hap-hazard greatly benefit, or greatly injure, acres of tree or plant growth.

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* Information regarding this form of spraying machine will be found at p. 99 preceding, under the heading of Paris-green.

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REPORT OF OBSERVATIONS

OF

INJURIOUS INSECTS

AND

COMMON FARM PESTS,

With SPECIAL REPORT on ATTACK of CATERPILLARS of the DIAMOND-BACK MOTH,

DURING THE YEAR 1891,

WITH METHODS OF

PREVENTION AND REMEDY.

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S. AUSTRALIA; HON. MEM. OF ENT. SOC. OF ONTARIO, AND CORR. MEMBER OF
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PREFACE.

The past year has been remarkable for presence (more or less) of most of our common farm and garden insect pests, and also for bad attacks of several kinds of which the habits and means of prevention had been little recorded previously. To give the long list of infestations regarding which inquiries were received, would be for the most part a mere enumeration of our best known insect pests, as Wireworms, Daddy Long-legs, Carrot grubs, &c.; but so far as I could judge by the reports sent to myself, there was a remarkable difference in amount of presence of some of our very commonest attacks. Some were present to an unusual amount, some unusually absent.

Amongst corn attacks little was reported of Gout Fly (*Chlorops*), though it was mischievous to some degree; and very little either of Corn Sawfly, or Hessian Fly; or of the deformed growth in Oat plants, known as "Tulip-root," caused by presence of "Stem Eel-worms." On the other hand Wheat-bulb maggot was prevalent and injurious to a serious extent; Corn Aphis was more than usually reported, and a few attacks were observed of the malformation of grains in Wheat-ears, popularly known as "Purples," or "Cockle-galls," which are due like "Tulip-root" to the presence of Eel-worms, though of a different species of *Tylenchus*.

The Mediterranean Flour Moth (see pp. 46—52) continues to spread its destructive presence in Wheat-flour mills and stores, and since my paper on the subject has passed through the press, I have been favoured from Dr. Charles Lindeman (the well-known authority on agricultural Entomology in Russia) with information of the pest having been discovered in a locality in Moscow, to which it had been imported from London in infested sacks.

Reverting to attacks on the growing crops. Amongst Turnip infestations the very common attacks of Flea Beetle, Surface Caterpillars, and Turnip Aphis, were less reported than is often the case. On the contrary; Turnip and Cabbage-root maggots were very injurious in various places. Turnip-seed and Turnip

Flower Beetles were well brought forward (see pp. 96—105), and attack of the caterpillars of the Diamond-back Moth was only too notably present.

Mangold-leaf Maggot was most unusually prevalent, and Mangold or Beet Carrion Beetle (an excessively rare infestation on crops in England) was once again present, though only to a slight extent. Celery-*stem* Fly was another rarely observed infestation.

Amongst fruit attacks the injuries caused by the caterpillars of the Apple and Plum Sawflies to the growing fruit, were infestations which have been little brought forward before. Raspberry attacks were also severe in various localities last year, and Mite-galls of the Black Currant continued to be a serious cause of loss to growers.

The success of the treatment adopted at Toddington and various other places for destruction of various kinds of "Orchard Caterpillars" by use of Paris-green sprayings, or by use of Paris-green, and also of sticky-bandings, will be found under heading of Orchard Caterpillars.

The remarkable and very injurious attack to Strawberry growth which appeared in 1890 in Kent, causing a malformation of the plant, but especially of the flowering portions, until, from the swollen and stunted appearance, they assumed the form of small Cauliflowers, has been little noticed in the past season.*

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* This was caused by the presence of Eel-worms of species previously unrecorded, of the genus *Aphelenchus*, and named by Dr. J. Ritzema Bos, of Wageningen, Holland, to whom I forwarded specimens, appropriately as the *Aphelenchus fragariæ*. Under this name Dr. Ritzema Bos has published various minute scientific papers on the subject, one entitled "De bloomkool-ziekte der Aardbeiten," and in his papers, and my more popular notice in my '14th Report,' we have adopted for the popular name that of "Cauliflower disease" of the Strawberry. Thus we follow the well and long known English, foreign, and American plan of naming forms of plant disease arising from Eel-worm presence, from their altered appearance, as "Tulip-root," Pine-apple disease, Root Knot, &c. Since the publication in our respective papers of the record of our observations (in which I had the honour of working with, I believe, I may say the highest authority on this branch of nematode observations), much of this information has been given by Dr. N. A. Cobb, at pp. 390—393 of the number for July, 1891, of the 'Agricultural Gazette' of New South Wales. The authorship is duly acknowledged, but very unfortunately the name is altered by Dr. Cobb to "Strawberry Bunch." Therefore as "bunch" conveys no definite meaning, and "Cauliflower disease" conveys the appearance excellently, I have thought it permissible (after consultation with Dr. Ritzema Bos) to draw attention to it being undesirable to change a name carefully given on accepted long-standing principles by the original observers; thoroughly acquiesced in by growers; and established in scientific treatises of three nations, for one bearing *no distinctive meaning*.—ED.

Serviceable advance continues to be made (by means of practical field observation) in knowledge of habits of both crop and fruit insects, which enable us to bring their attacks under the power of preventive measures practicable at a paying rate; and besides increased information of measures which can be brought to bear in ordinary course of husbandry, we have advanced in knowledge regarding useful insecticides and implements for their application.

Personally (as in each previous year) I desire to offer my sincere and cordial thanks to the many good friends, both in this country and wide-spread over the world, who have again assisted, not only by the definite help recorded together with the observations in which they have aided me, but also by much kind encouragement.

To the agriculturists of this country, and also to our Agricultural press, and to much of our general press also, I am greatly indebted, and I think none of them will differ from my own full belief (often expressed) that the greater part of such value as my yearly Reports may possess is as the record of the sound observations which I have now so long had the honour of receiving for publication year by year, and which I trust I may still be favoured with.

Of the wood engravings, those at pp. 11, 58, 96, and 105, are given by permission of Messrs. Blackie & Son, of Glasgow; the moths with wings extended at pp. 66 and 69, by permission of Messrs. Allen & Co. The moth in act of walking at p. 66 is after Dr. Taschenberg. Of such of the other figures as are partly taken from published authorities, the source is acknowledged beneath the figure, or in the letterpress on the same page. The remainder are from drawings made for my own publications by Mr. Horace Knight, artist to Messrs. West, Newman & Co., or in some few instances from my own drawings.

Just a few lines may appear to be called for to explain the great length of the report on attack of "Diamond-backs." So far as I can judge from reports sent me, or from research in previous records, this outburst (taken as a whole) was unexampled in this country, and I have endeavoured, to the very best of my power, to preserve its history accurately. To make this of value for reference, whether entomological or agricultural, it has seemed to me necessary to have certainty of the nature of the attack as far as possible *in every case recorded*, and of effects of treatment not merely on the scale of experiment, but of results of applications to the broad areas of Turnip land reported along the infested country.

It may most truly be said of this attack that it involves unusual amount of meteorological and botanical considerations, as well as those customarily found in the attacks of crop insect pests. Therefore for those who care to study the points in detail, the reports with which I have been favoured are laid before them; but for other readers the "General Summary" appended gives, so far as I am able, a condensed view of the main points.

ELEANOR A. ORMEROD,
Honorary Consulting Entomologist of the Royal Agricultural Society of England.

TORRINGTON HOUSE, ST. ALBANS,
February, 1892.

LIST OF
ATTACKS OF INJURIOUS INSECTS, OR INSECT ALLIES,

NOTICED IN THE FOLLOWING REPORT.

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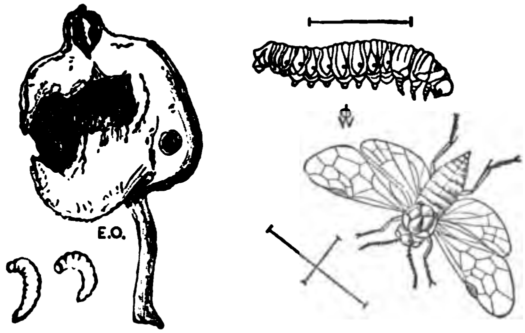
NOTES OF OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON CROP PESTS
DURING 1891.

APPLE.

Apple Sawfly. *Tenthredo* (*Hoplocampa*) *testudinea*, *?* Klug.*



TENTHREDO (HOPLOCAMPA) TESTUDINEA.
Female Sawfly and caterpillar, magnified, with lines showing nat. size, after Prof. J. O. Westwood;† caterpillars nat. size, and infested Apple.

ATTACK of Apple Sawfly caterpillars has not been much reported up to the past season, but from last summer's observations it seems probable that this infestation is more prevalent than is commonly supposed, only not generally recognised owing to there being many points of resemblance between this attack and that of the caterpillars of the Codlin Moth.

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* From the appearance of the caterpillar of the Apple Sawfly, and likewise from its habits and the characteristics of the attack, it scarcely appears open to doubt that it is the larva of the *Tenthredo* (*Hoplocampa*) *testudinea*, Klug; but as we have not as yet reared the perfect insect (the time not being yet come for its development from our specimens), I give the scientific name with a note of interrogation.

† See 'Gardeners' Chron.' vol. for 1847, p. 852.

Apple Sawfly attack has long been known to be present in this country. So far back as 1847 this infestation was described, from his own observations, by Prof. J. O. Westwood; but it was not until the past summer that I had an opportunity of observing the method of attack myself, and with the assistance of Mr. W. Coleman, of Cranfield, Beds, making out some points in the history of the caterpillar which (so far as I am aware) have not been previously noticed.

On June 24th, Mr. Coleman sent me specimens of injured Apples, with the remark:—"The young fruit of the Apple is being again subjected to wholesale destruction in my orchards, by a grub which pierces the young fruit when about the size of a small bean up to a cob-nut. I have not seen any larger affected; when they get beyond this cob-nut size they appear to be safe from attack."

The little Apples forwarded to me were injured in a manner that might have been caused by Codlin Moth caterpillars, but no caterpillars of any kind were then present in them, and Mr. Coleman mentioned that those he had found differed from those of the Codlin Moth in various points specified.

On June 29th, according to my request, Mr. Coleman forwarded me some caterpillars for examination, with the remark that the attack had extended all over the orchard, and seemed likely to clear most of the fruit. On taking these grubs out of the quill in which they were sent, I noticed a smell just like that of a plant bug, or common bed bug, which at once suggested a species of Sawfly caterpillar was present, and on examination I found that, besides three pairs of claw feet, and likewise a pair of sucker feet beneath the tail, they possessed six pairs of sucker feet beneath the body. Consequently they were quite certainly not Codlin Moth, but Sawfly caterpillars, and of these the largest specimens agreed with the description of the caterpillars of the Apple Sawfly (the *Tenthredo testudinea* of various writers) given by Prof. J. O. Westwood.

Presently, that is, on July 11th, when I had had the opportunity of examining caterpillars of various ages, I found that those in the earliest stages of which I had specimens differed from the larger ones in having shining pitchy or black heads, and the markings above the tail being also pitchy or black; and as, in case this change of colour in moulting has not previously been recorded, it is of a good deal of practical importance, I give my own notes just from the specimens sent, followed by Mr. Coleman's careful reports, up to absolute observations of the moult of the black-marked head and tail, and appearance from within of the caterpillar as usually previously noticed.

On July 11th the Apple Sawfly caterpillars sent me, apparently full grown, length between three-eighths and half an inch, were whitish or creamy in colour, head pale chestnut, eyes black, jaws dark brown in front, plate above tail, and cross band immediately preceding, mottled with grey. Three first segments each with a pair of jointed legs; fourth segment without appendages; fifth to tenth segments each furnished with a pair of sucker feet somewhat like blunt tubercles, tail segment also furnished with a similar pair, not so noticeable, however, excepting when in the act of walking, the caterpillar or larva thus possessing twenty feet in all.

In the early stage (that is, in the case of specimens a little more than one-eighth of an inch in length) the head was shining pitchy or black; the plate above the tail was also shining pitchy or black, and immediately preceded by one cross band of similar colour, and this again by two narrower and shorter streaks, also black or pitchy. The black tail plate and the preceding band sometimes formed one mass.

The claw legs were darker than in the older specimens; the abdominal sucker feet were difficult to count in these very little specimens, which were somewhat shrunk in transmission, but by careful pressure in fluid, and with the help of a two-inch object glass, I was able to expand them so that there appeared no doubt all six pairs were present.

The small Sawfly caterpillars, black or black-marked at head and tail, and the larger and pale-marked caterpillars, were presumably of the same species; but I was indebted to Mr. Coleman for proving the point by direct observation of the pale-marked caterpillar leaving behind it the black-marked skin, and by his favouring me with the following notes.

A section of a fruit containing a caterpillar, with black head, &c., three-sixteenths of an inch long was placed under a glass. On the following day it had considerably increased in size, still feeding on the fruit (black head, &c., still noticed), and on the next following morning, July 1st, the black head or collar and tail had given place to the pale colour, and the grub had left the fruit and was travelling round the rim of the inverted glass. On examination of the Apple on which the grub had fed, in its successive black-marked and pale-brown-marked conditions, Mr. Coleman noted, "There were, clear enough, the black helmet, tail piece, and skin, shed within the Apple."

Mr. Coleman observed the grubs in stages of growth from less than one-eighth up to three-eighths of an inch long, always with the same number of feet (thus showing there was no confusion of the little creatures with the caterpillars of the Codlin Moth), and found that the black helmet and tail piece were shed with the skin at a certain period, giving place to the pale brown. Evidence of this was plain by the remains of the first coat being found moulted off, and heaped up in the burrows, in several specimens of the fruit gathered from the trees.

Mr. Coleman found two and even three caterpillars in one fruit; also that even before they left the fruit, for their change to the chrysalis state, they were *by no means necessarily stayers at home.* On July 1st, "the morning being damp and showery," Mr. Coleman found "the grub in all positions, both black and pale heads and tails; some hanging half out of the fruits; some apparently taking their departure on the foot-stalk of the leaves near to a fruit; and two days after, a full-sized specimen (half an inch long) was taken from a perfect fruit, into the side of which it had not, when extracted, eaten its full length."

I had the opportunity myself of seeing the operation of the caterpillars, after leaving the Apples, burying themselves in the earth, which is a serviceable part of the history relatively to means of prevention. In the instances I watched, this took place about the middle of July or rather earlier, and the peculiar bug-like smell, which these caterpillars have the power of emitting, was very observable when a specimen of the caterpillar was handled in being placed on the earth.

The injured Apples were not as regularly tunnelled as in the case of injury from the Codlin Moth caterpillars. There were tunnels, but also, as in the example figured at heading, a good deal of the inside of the little Apple might be eaten away, thus causing a rough blackened cavity with decaying surface. As a matter of course, when so greatly injured, the growth of the Apple is checked and it drops, and attention is drawn to where attack is present by the quantity of little fallen Apples beneath the tree.

In a communication which Mr. F. R. Murray, of Walton House, Walton, near Ipswich, also sent me (on the 8th of July) regarding the same kind of caterpillars, he likewise noticed the habit of the grubs of straying about. He remarked, "The grub seems sometimes to leave the Apple it was hatched in and then crawl to the next, touching it; and so the same grub seems to spoil many." It was also observed, as with the grubs previously mentioned, that the smell was "dreadful," and in the part of the garden where the attack took place the quantity of fruit destroyed was very great.

The observations taken in the past season agree so well with those of Prof. Westwood, so far as they refer to the same parts of the life-history of the grub, it seems to me, although we have not yet reared the Sawfly, that it is hardly open to doubt that the infestation is that scientifically described, formerly, as of the *Tenthredo testudinea*, now of the *Hoplocampa testudinea*, Klug.

The method of attack, as given from his own observations by Prof. Westwood, is, that in May he saw the female Sawflies on the wing amongst the Apple blossoms within which they settled, and on one occasion he "distinctly saw one of the females bend down the extremity of the body in the act of depositing an egg within the blossom."

The observations of Delacour de Beauvais, as quoted by Kaltenbach,* also mention that the perfect insect flies in May about the Apple blossoms, and lays its eggs in the blossoms.

The female Sawfly is figured at heading (p. 1) from Prof. Westwood's drawing. The upper surface of the body is described by him as "shining black, the front and sides of the head and shoulders, antennæ, legs, and under side of the body being pale orange coloured, and the wings are slightly stained with brown."

The published observations which I have seen, whether German or English, concur in the grubs falling to the ground in the infested fruit in June or July, or as soon as the little Apples are so much injured within that they can no longer adhere to the tree; and that the Sawfly caterpillar then makes its way out, to go through its changes in the ground. There (quoting again from Prof. Westwood) they form their cocoons, and remain inactive until the following year, when in May the perfect Sawflies make their appearance from the buried chrysalids.

In the orchard observations of the past season, the caterpillars were noticed as straying from one Apple to another, but not either as crawling down the trees or dropping to the earth independently of the Apples.

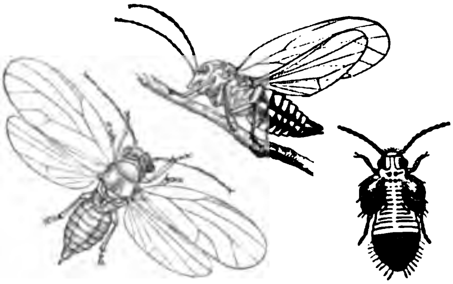
PREVENTION AND REMEDIES.—As the caterpillars go down into the earth for their changes to the chrysalis and thence to the perfect insect, it would be a sure method of greatly lessening recurrence of attack to find out, by careful examination, how deep down the cocoons lie, and then skimming the surface deep enough to clear them all off. The infested soil should be buried well down or thrown on rubbish fires, so as to make sure of destroying the contained pests, for unless this is done the work of removal will only be so much wasted labour. Gathering up the fallen infested Apples and destroying them is also very desirable.

So far as I see from Apples sent me, the caterpillars may remain for some time in the Apples after they are removed from the tree, but where there is much attack noticeable, it would be worth while to spread some large cloths under the trees successively, and shake the boughs. The Apples which fell might thus be collected and carried away, and destroyed before the caterpillars escaped.

Mere dressing of the surface even with gas-lime does not appear, from notes sent, to prevent attack.

* 'Die Pflanzenfeinde,' p. 201.

Apple-suckers, or Chermes. *Psylla mali*, Schmidberger.



PSYLLA MALI; pupa of P. PYRI.

Apple-suckers, from life, with wings expanded, and also raised as in the act of taking flight; nat. length one-twelfth of an inch. Pupa of Pear-sucker, mag., after Prof. W. Saunders.

During the summer of 1890, the little Apple Psyllas, or Chermes, were so thoroughly observed, and their life-history recorded in the observations of Mr. W. F. Gibbon, of Seaford Grange, near Pershore, and those of Mr. J. Hiam, of Astwood Bank, near Redditch, that there seems little need to say anything more on this subject. But in the past season, early in the year, Mr. Hiam found that the damage which the *Psyllas* were doing to his trusses of Apple blossom was so exceedingly great that he arranged a simple form of apparatus, by which he was able to capture the insects so successfully by hundreds, on an adhesive surface, that I give a short note of his method of operation.

The Apple Psyllas or Apple-suckers are very minute insects, of the shape figured above, only about the twelfth of an inch long. The general colour during most of their lives is Apple-green, but is varied in the mature insect in autumn with different tints, especially of red; in the words of Mr. W. F. Gibbon, " some red from head to tail, some only red about the head and shoulders, some quite green, and some milky-white." At this time the minute white or yellowish eggs, which are somewhat spindle-shaped or sometimes blunter at the extremity, are laid in furrows, or hollows, or on the down or slightly woolly growth near the extremity of the Apple twigs. From these eggs the young *Psyllas* hatch in the following spring. These are in shape much like their parents, excepting that in their early stage they are wingless.

These little Apple-suckers, where numerous, do great mischief by sucking away the juices of the young Apple buds, or stalks of the blossoms, or blossom buds.

Early in the past season (1890), Mr. Hiam sent me information of the damage which the *Pysllas* were doing in his orchard, by weakening the middle blooms of the truss, where they could shelter themselves from insecticides, and mentioned the injured trusses might be pulled off and shaken down like chaff; in fact this season they had done him much more harm than the caterpillar attack.

To check their increase, he arranged what he mentioned as a "handy weapon," which may be shortly described as made of sundry pieces of tin fastened at the end of a long wooden lath, which served as a handle. These pieces of tin being well smeared with some greasy mixture, this adhesive surface could be raised by the long wooden lath, and waved at pleasure amongst the infested shoots, and by this simple means the *Psyllas* flying from the buds were caught in enormous numbers.

Mr. J. Hiam thus described in detail how he made his apparatus: —"I unsoldered some Tomato tins, and levelled them out flat, discarding the ends or round portions. I procured a piece of slate lath about four feet long, and smoothed the handle, and nailed four tins on the top, overlapping at the joints. I mixed some tree-dressing grease thin with a little linseed oil, and well smeared both sides of my handy implement.

"As the flies or adult *Psyllas* fly off at one's approach, they are slashed away at right and left, taking them at both strokes. By this simple plan I can easily destroy 5000 in an hour, ascertained by measurement of the surface and counting the insects on a square inch."

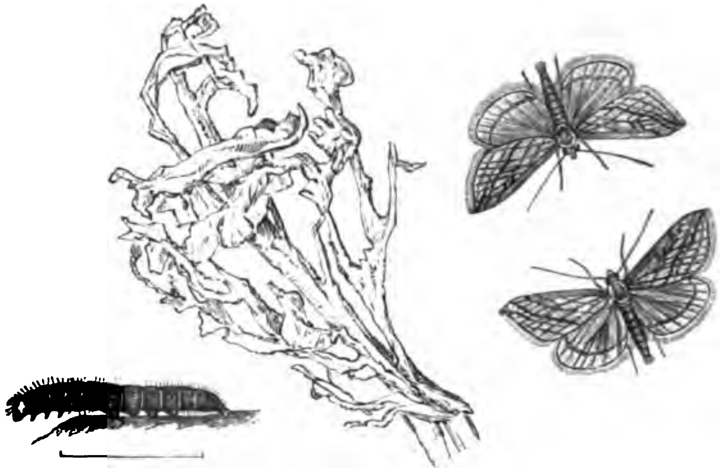
Mr. Hiam noted that it was advisable to re-dress the tins pretty often with grease, as otherwise, if the insects only came in contact with the bodies of those already adhering to the grease, they would escape capture. Also, he noted that many more could be caught in brilliant sunshine than on dull days.

The attack of the Apple Psyllas does not appear to be one at all generally observed, but where it occurs it has a power of doing a great amount of damage.

NOTE.—For life-history of the *Psylla mali* from English observations, together with means of prevention or remedy, and also references to foreign notices, see my 14th 'Report on Injurious Insects,' pp. 4—11. —E. A. O.

CABBAGE.

Cabbage-garden Pebble Moth. *Pionea forficalis*, L.[*]



PIONEA FORFICALIS.

Moths, nat. size; injured leaf; caterpillar, mag.[†]; line showing nat. length.

The Cabbage-garden Pebble Moth is a kind which was observed as long ago as 1884 as "very common in the neighbourhood of London and in most parts of the country," and the caterpillars are known as being very mischievous, where they occur in large numbers, to plants of the Cabbage tribe, and especially to Horse Radish. The above figure, sketched from one of a number of equally injured specimens sent me from Huddersfield by Mr. S. L. Mosley, shows the power of the caterpillars of clearing away the soft portions of the leaves until scarcely anything but the harder veins and mid-ribs remain.

The moth is of the size and pattern figured above from life; the colour of the upper wings pale yellowish or ochrey, marked with four more or less distinct very narrow oblique rusty or brown streaks, also a kind of dash of the same colour at the top of the wing, and a spot somewhat behind the middle of the wing; the hinder wings whitish yellow, with a faint brownish streak running parallel to, and a little way within, the margin; all the wings bordered by a narrow brownish line on the hinder margin.

The largest specimen of the caterpillars sent me was rather over

[*] The English name of the moth, though somewhat cumbrous in its entirety, is appropriate, as pointing to the infestation having been specially found in gardens. The generic name of *Pionea* is used at the present day, but this moth is also given by some writers under the synonyms of *Mesographe* and *Botys*.

[†] The caterpillar is figured rather darker than life, in order to show the white lines between the segments.

three-quarters of an inch in length; the general shape cylindrical, gradually lessening to the tail extremity; feet 16, that is, 8 pairs of claw feet, 4 pairs of sucker feet beneath the body, and another pair (much extended) beneath the tail segment. The head greyish; under a magnifier, of a pale greenish tint with many pale grey markings; and the next segment slightly horny and greyish above. General colour greenish, brightest below; above greyer, with a central stripe, and stripe along each side darkest, the tints between these stripes yellowish, and along each side, beneath the dark stripe, a whitish longitudinal line; the upper part much freckled with minute white markings, and the segments with faint white lines between; spiracles black.

The following observations of the habits of this "Cabbage and Horse Radish Moth" were sent me, on the 28th of September, from Huddersfield, by Mr. S. L. Mosley, F.E.S.:—"One of our regular pests in garden *Cruciferæ* and Horse Radish is the 'Garden Pebble Moth,' *Pionea forficalis*. This year I have let it have its own way on a small bed of Turnips in my garden, and I thought you might like to see the results, which I send." . . . . "Garden Turnips and Horse Radish are often riddled in this way. I know of several gardens just as bad at the present moment." A few days later Mr. Mosley wrote further:—"I have watched *P. forficalis* a good deal." . . . . "I believe it is generally common, for I have found the larvæ at work wherever I have looked for them (under favourable circumstances of course), and I remember seeing both Cabbage, Turnip, and Horse Radish badly eaten at Isleworth." . . . . "Attacks are very usual here, and I could send you leaves like those I sent any season. I find the moths, in ordinary seasons, first appear about the third week in May, and the larvæ are feeding during the latter half of June and July; and a second brood of moths come out towards the middle of August, the second brood of larvæ feeding through September and into October; but in some seasons (*i. e.*, warm ones) there seems to be a succession of broods, for I have taken what appeared to be fresh imagos and larvæ at the same time."

Mr. Mosley mentioned that he had not seen the pupa in its natural condition, in fact he had not searched for it; but in confinement this was formed in a slight cocoon spun on the surface of the soil amongst dead leaves.

Dr. Taschenberg* mentions that when the caterpillars have reached their full growth they go a little below the surface and spin a somewhat cylindrical cocoon, in which they turn to a very shiny brownish orange-yellow chrysalis (of which a full description is given). In this condition they lie during July; the second brood of moths appearing in August, and in October the second brood of caterpillars goes down into the soil, from which the moths appear in May.

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* See 'Praktische Insekten Kunde,' pt. iii. p. 240.

Kaltenbach * mentions the caterpillars as feeding on the under side of the leaves, gnawing them into holes, and even consuming them to the mid-rib. Taschenberg (see previous reference) notes their feeding on the leaves of various plants of the Cabbage kind, "where they keep themselves as much as possible concealed amongst the folds of the leaves, and spin thread over the entrance to their retreats." In the case of specimens sent me together with leaves, I found enough thread (some loosely spun, some across a hollow in the leaf) to show the capability of the caterpillars for this work, and subsequently some spun, firm, white cocoons.

PREVENTION AND REMEDIES.—Mr. Mosley mentioned that "the larvæ readily fall from the plant, and if knocked down as soon as mischief is detected, and a good dressing of soot or lime given, they are readily got under." Probably trampling the ground would destroy a great many; or, as this infestation appears to be especially considered one of the Cabbage garden, turning poultry in might be expected to do a great deal of good.

In many cases, although the caterpillars may be mostly on the under side of the leaves, these could be treated with a preventive dry dressing by throwing it sidelong amongst the plants. With Horse Radish and various kinds of Cabbage, a portion of the under side of the leaf would certainly be reached; and if some good dressing, such as Fisher Hobbs' mixture (see Index), was used, it might be expected, between what fell on the previously fallen caterpillars, and what flew about so as to adhere to the leaves, that many of the grubs would be killed, and much protection given to the leafage.

Trenching infested ground so as to put the uppermost spit down, and what was previously below on the top, would get rid of the chrysalids which lie near the surface. Even if they did develop at the unnatural depth, the moths would not be able to make their way to the surface through the superincumbent weight of earth. But in this, as in all other cases of destroying infestation by trenching it down, it should be remembered that, to ensure benefit, the pest *must be left down*. If measures of cultivation for the next succeeding crop should bring the pest to the surface again, whilst it is still alive, and (in the case of moth chrysalids) still capable of development, no good, save cultivation of the ground, will have been done.

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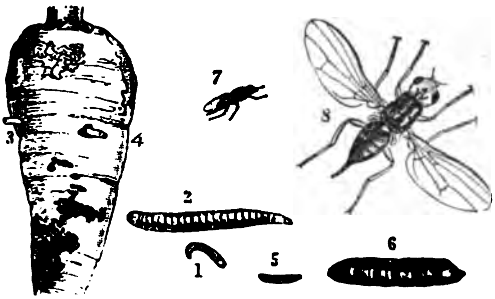
* 'Die Pflanzenfeinde,' p. 28.

CARROT.

"Rust." **Carrot Fly.** *Psila rosæ*, Fab.



PSILA ROSÆ.

1, 2, and 3, maggots of Carrot Fly, nat. size and mag.; 4, infested Carrot; 5 and 6, pupæ, and 7 and 8, Carrot Fly, nat. size and magnified.

Carrot attack, commonly known as rust, is a constantly recurring cause of loss, and probably will continue to be so as long as the requisite treatment is put off until the presence of the grub at the roots is shown by the discoloured and dying leaves, instead of measures being taken previously, at the right time, to prevent the Rust Fly going down into the ground by the Carrots to lay her eggs, and thus start the infestation. A large proportion of the minute directions given by successful Carrot growers as to composts, preparation of ground, &c., turn on this point, that is, having the land in such a state that it will not draw away into cracks and so lay the roots open to attack; but besides this, the great point of all in forestalling attack, and one without attention to which all other measures may fail, is such treatment at thinning time as may deter attack, or may so close the disturbed and shaken open ground that the Carrot Flies *cannot* get down to the roots.

These facts have long been known, and the best methods of cultivation adopted for meeting the difficulty, contributed mainly by Scottish superintendent gardeners, have already been given in these Reports; but during the past year so much advance has been made, both in variety of insecticides and methods of applying them, that I give a few suggestions once again as to treatment at thinning time.

The method of life of the Carrot Fly is to go down into the ground, where she can find a chink or cranny, by the Carrots. There she lays her eggs on or by the roots, and the little yellowish or whitish maggots which hatch from these work their way into the root itself, or, if this is still very small, often destroy the lowest part. When full fed they leave the Carrots, and turn to the chrysalis state in the ground. The chrysalis cases are cylindrical and of a rusty or ochreous colour, and from these (in summer) the little blackish green two-winged fly, with a rusty-ochre coloured head, comes out in about three or four weeks.

The few following notes are given just to show the mischief the attack is still causing, and, in the first, mention is made of the mischief beginning at the time of the last thinning.

I was favoured with this report by Archdeacon Henry de Winton, of Llandrindod, Radnorshire, on the 14th September. Mr. de Winton observed:—"The Carrot has now, for three years in succession, been completely destroyed in my garden by the pest known as 'the Carrot grub.' Its ravages are probably well known to you. This year, after carefully preparing ground for Carrots by deep digging in the previous autumn, I dressed it heavily, first with salt, then with *soot* fresh from the chimney early in the spring, and thirdly with quick-lime just before sowing.

"The seed came up, and grew admirably until about the end of July, when I had just given the plants their final thinning; since that date the grub has completely destroyed the most flourishing beds of Carrots that I have ever grown, the only difference between this and the two previous years being that this year the ravages of the grub have commenced a little *later*. In other respects the dressing of salt, soot, and lime seems to have produced no effect whatever in the way of prevention; nor have further applications of soot and lime, in the way of arresting the ravages of the grub when first evidenced by the fading of the leaf.

"When taken up, the root is found to contain several creatures resembling small white maggots, which have eaten their way into it, commencing at the lower extremity. I may add that mine is a garden first cultivated six years ago, with varying soil from stiff clay to light loam, and that for the last three years Carrots have been sown in different soils with the same result. Previously the crops of Carrots had been very good, and entirely free from any such injury. Some of my neighbours have suffered from the same pest."

Another correspondent, from the neighbourhood of Kelso, N. B., notes injury to Carrots beginning when the roots are of some size, and that its advent means complete destruction of the crop, although the soil is admirably adapted for the growth of vegetables.

Another enquirer, Mr. James Somerville, writing from Park Place, Alloa (Co. Clackmannan, N.B.), with specimens of maggots taken from Carrots accompanying, asked what could be done in the way of preventing these destroying the crop. "I have tried, year after year, to grow this vegetable, but find, when they are about half-grown, the under leaves turn quite *rusty*, and on pulling them up these maggots are seen to be boring through the root. I have tried them in fresh pasture land, in case the ground might be foul, but always with the same result, failure."—(J. S.)

So far as I can tell, it appears that *unless care* is taken in cultivation, and in the various common-sense measures which suggest themselves to all (such as not sowing on previously infested ground), infestation is much more likely than not to appear; and that even *with every precaution*, if proper measures are not used at thinning time, the crop may be ruined by the " Rust " maggot.

We have notes of failure on good land, on fresh land where the ground could not have been previously infested, and also where care had been taken in preparation and manuring of the ground.

Bruising the young plants by careless treatment (as by treading among them) will also bring attack, as I found in my own garden in 1890. Large clumps of Scarlet-runner Beans happened to be placed at distances along one side of a long border of Carrots. The man employed to stake the Beans carelessly trampled the Carrots close by, and shortly the discoloured leafage showed the mischief had begun in front of the Bean clumps, which gradually spread on each side of the injured spots, so that the border was very obviously alternated by the cross stripes of good and bad Carrots.

The fact of attack following exactly on thinning operations was well shown in a note sent from near Dingwall, N.B., where, in 1880, it was observed that on beginning thinning, the grub began too, " and within three weeks spoiled them for use." . . . . "Late ones alongside escaped until we began to use them; but by keeping to the side the grub was on, it kept up to, but did not advance beyond, the damaged part."

How far the Rust Fly may be attracted by the smell of the bruised Carrots cannot surely be known with certainty; but it is strongly advised to remove all dead and dying plants, and broken pieces of root or leaves, after thinning. Copious watering after thinning (unless weather is such as to make it undesirable) acts well, both by closing the disturbed soil and preventing the growth of the disturbed plants being checked.

In garden cultivation this may often be done simply by the use of a garden watering-can. Where there is water supply and a hose, I have found sending a single jet of water from it *very hard*, in a straight line between or beside the rows, to answer well for slight earthing up. The force of the water tears a shallow furrow, and sends the earth flying on both sides of it on to the plants to be protected, and also gets rid of insect vermin that may be about. Any application, mixed with the water, which is beneficial to plant growth and objectionable to insects, is of course desirable.

For refreshment of the plants themselves, where there may be a larger extent of Carrot beds to be attended to, the use of the Eclair knapsack sprayer (which was generally introduced, for orchard spraying and other purposes, into this country in the course of the past season) would be likely to be very serviceable. The spray might be given according to the position in which the delivery tube was held, either so as to fall on the leafage or to go amongst it just above ground level. Then the thorough though gentle moistening would be good for the plants, and deterrent to insect infestation, even if only of pure water; also it would to some extent moisten and "firm" the surface of the ground.

Where wished, any fluid deterrent, or plant stimulant, could of course be used. Soft-soap and sulphur compound (see Index) might be expected to be useful. Where I have tried this, much diluted as spray for Peaches and other wall-fruit trees, I have not found the slightest injury result to quite young leafage in the spring, and the slight stickiness of the soap, and smell both of the soap and sulphur, would be likely to be very deterrent to the fly if sent amongst the leafage. The strength that is safe should be tried before use on a large scale.

Sand moistened with paraffin oil, and strewed amongst the Carrots and then watered in, has been found to answer as a preventive. In this case, probably, the proportion of one quart of paraffin to one bushel of dry material,—as sand, dry earth, or ashes,—would probably not do harm, as we have found, in experiment on a large scale, that Hop shoots, growing up *through* a dressing given in this proportion to a number of Hop hills, were not the least injured.

From observations in my own garden, a dry dressing sown together with the seeds (in addition to other applications) appears to answer well. Besides the customary treatment, my gardener sowed a mixture of soot and lime with the Carrot seed, and thus when thinned the smell of the application was stirred up round the disturbed plants. The result has certainly been good, for we have not been troubled at all by Rust Fly, and have an excellent show of plants.

The details of Carrot growing, relatively to preservation from Rust Fly, have been given so fully in previous Reports and in my 'Manual,' that I do not enter on these; but the special danger to the crop being from the flies getting down cracks in the soil, and that this is most to be guarded against at thinning time, appears to need a word. In the preceding pages I have only given a few notes of methods of treatment, for these could be varied to any extent according to nature of appliances at hand, or views of the owner as to insecticides, but working on the above principles.

CELERY.

Celery-stem Fly. *Piophila apii*, Westwood.

Celery stem injured by maggot borings.

The attack of the Celery and Parsnip-leaf Fly, of which the maggot (in some years) does enormous damage by burrowing between the upper and under side of the leaf, and consequently destroying it in large patches, is well known; but the great mischief sometimes caused by the maggots of another kind of two-winged fly tunnelling in the lower part of the Celery stem, is apparently of much rarer occurrence.

On the 29th of July, Mr. Edw. Riley, of the Weir, Hessle, near Hull, when writing to me of some insect injuries which had been occurring at Epworth, added, "But the most serious attack is on twenty acres of Celery (Mr. Blaydes grows seventy-eight acres): a white grub, the size of the caterpillar on the Cauliflower (*i. e.*, about half an inch long.—E. A. O.), had *completely* eaten off the plants, about an inch within the ground; you could go down the rows and see all the tops pulled up. I never saw such destruction, scarcely a plant in a hundred left growing," . . . . "It appears to be something new. Last year they had a slight attack; it seems to be spreading in the district."

Specimens of the infested plants were forwarded me by the owner, drawing my attention to the destruction of the tissues of the root by the grub, and on examination I found the attack corresponded with that described by Prof. J. O. Westwood,* as caused by the infestation of maggots of the Celery-stem Fly, scientifically the *Piophila apii*. The above figure, which is taken mainly from that by Prof. Westwood, gives an idea of the stem when moderately attacked.

I found, in the plants sent me, that the thick base was pierced by workings in which the larvæ, or maggots, were present, and the lowest part was, in some instances, completely killed, this involving gradual death of the roots and of the whole plants. The maggot galleries often extended some way up inside the stalks of the leaves. This exactly corresponds with the description given by Prof. Westwood of "the larva burrowing into the solid stem and fleshy stalks, working its way up the latter."

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* See vol. of 'Gardeners' Chronicle' for 1848, p. 332.

On the 3rd of August, I found several maggots had left the Celery, and were moving about in the dry earth, on or in which the Celery was laid. These were about a quarter of an inch in length, or rather more when extended, yellowish white, and very shiny, and somewhat transparent; the shape cylindrical, narrowed at the head extremity, which is pointed when in movement, and obliquely rounded at the tail, which is furnished with two black spiracles; these are noticeable with an ordinary low-power hand-magnifier.

With an inch object-glass the spiracles appeared to be joined at the base by a black substance, and the tracheæ might be clearly observed passing on from the spiracles into the larva. At the anterior extremity (*i. e.*, towards the head end of the maggot) the tracheæ were furnished with external and branched spiracles, and, so far as the movements of the maggots would allow of counting these branches, they were about six in number. It was only occasionally that I could gain a sight of the expansion of the branches in which the spiracles terminated, so that for the most part these appeared simply exserted without division; but with a quarter-inch glass, and the larva at rest, I was able to make out clearly that one spiracle had six branches, besides what appeared to be the broken remains of another. The larvæ frequently curled themselves into a circle, head and tail together.

I am not aware of any description having previously been given of this larva, excepting that published by Prof. Westwood on his first observation of the attack in 1848 (see previous reference), of which I therefore append the main points, to show the similarity of the infestation.

"The larvæ are glossy white, cylindrical, grubs, having the anterior part of the body pointed, and the hind part obtusely rounded and marked by two black points, from whence proceed two delicate air-vessels, appearing like threads of gold beneath the transparent skin, and which run along the whole length of the body, as far as the segment immediately behind the head, where they form two minute exserted appendages." . . . "The mouth consists of a black horny apparatus, capable, as well as the head itself, of being withdrawn into the subsequent segment, as far as the two exserted lobes of the air-vessels above mentioned."—(J. O. W.)

Amongst the specimens sent to myself from Epworth, a second kind of dipterous maggot was present, but, as far as I could judge, only to a small extent, and probably only preying on decayed matter. This was distinguishable by the caudal extremity *not* being rounded, but rather slightly dilated, and furnished with numerous tubercles. To make sure that this was not merely an early stage of the larva of the *P. apii*, I examined a series of these in different stages of growth, and found these, from the smallest (which might be about an eighth of the size of the largest I had), all corresponding in structure.

Circumstances prevented me, at the time, following up details of life-history; but these will be found given at length by Prof. Westwood, with figure of the fly, maggot, and other details, at page of 'Gardeners' Chronicle' for 1848, previously named. From these I may quote, shortly, that Prof. Westwood found the maggots present in the Celery in the month of February; that these maggots turned, in the diseased Celery stems (or in the earth in which they were placed), to chrysalids or pupæ, within an elongate oval case formed by the hardened maggot skin; and from these chrysalids the two-winged fly came out about the middle of May. This fly he found to be very like the common Cheese Fly. It was about three-eighths of an inch in spread of the wings; thorax and abdomen black; head mostly chestnut colour; legs very pale straw colour, feet more dusky; wings colourless, with veins very pale buff. The body is described as sprinkled with fine golden grey hairs.

PREVENTION AND REMEDIES.—The observations of the past season have added to those previously quoted, the certainty that there is a summer generation, as I found specimens, only somewhere about the sixteenth of an inch long, amongst those sent me at the beginning of August. The second brood is presumably very soon developed from chrysalids of these maggots, and if any measures could be taken to destroy these it would save much mischief.

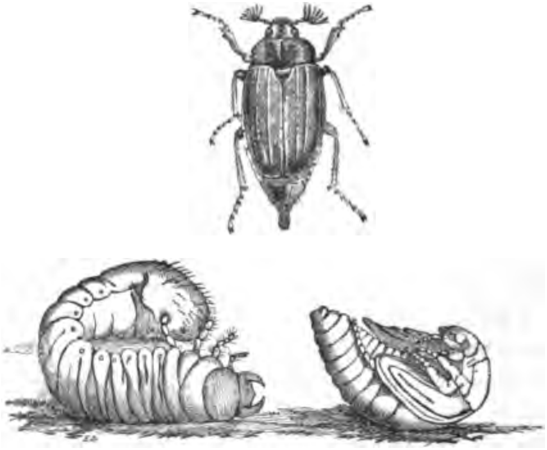
For one thing, whether with summer or winter infested plants, a rule, stringently carried out, that the plants were in no case to be thrown to the manure heap, but burnt, or buried in wet manure, or so treated that any chrysalids which might be in the stems should be destroyed, would save some infestation.

Where there has been a complete destruction of the plants by infestation, probably a heavy dressing of gas-lime along the trenches, and leaving the ground free until the air had neutralised the noxious qualities, would destroy such chrysalids as might be in the earth. Or, again, turning the earth well down into the trenches, and planting on these some winter crop, which might be dibbled in, would at least secure a return from the ground, though not in Celery, and would leave the insect vermin buried safely down, out of the way of infesting other plots.

If any practicable measures of checking this attack are known by Celery growers, it would be a great advantage to all if they would make them known, for though palliatives may possibly be brought to bear, it is much more likely than not that, where such a large area as seventy-eight acres of crop is grown, there is no means of getting the infestation under,—of a maggot feeding *within* the plants, and a fly, only about the size of a Cheese Fly, *without*,—except a change of crop. Thus, as with Mustard Beetle, and other attacks of insects to crops grown largely and long in a district, by removing the chief food of the pest it may not be totally cleared, but its overwhelming presence is locally checked.

CORN AND GRASS.

Cockchafer. May Bug. *Melolontha vulgaris*, Fab.



MELOLONTHA VULGARIS.
Common Cockchafer, maggot, and pupa.

The following notes regarding the grub of the common **Cockchafer** Beetle, are inserted to show how near the surface of the land they may be found in winter. Also as giving practical example that, though grubs or other insects can bear severe cold, so long as they are in the shelters which they have made or chosen for themselves, yet if turned out of these on to the surface, where they are *exposed* to influence of unfavourable weather, and from this, and possible winter torpidity, are not able to shift for themselves, multitudes may thus be destroyed.

On the 2nd of February, Mr. J. England Wilson, writing from Springhill, Skene, Aberdeen, N.B., forwarded me a Cockchafer grub, with enquiries as to its nature, and mention that it was found in that neighbourhood, but only in good land when it was being ploughed.

One great difficulty in dealing with this attack is the depth at which these long-lived grubs shelter themselves beneath the surface in winter, which may very possibly be lower than where they can be turned out by common measures of cultivation. The regular method of life (as is well known) is for the female Cockchafer to go down, in early summer, some six or eight inches deep in the ground to lay her eggs. The grubs which hatch from these come up to within a few inches of the surface of the ground to feed, and attack the roots of Grass, various kinds of crops, and young trees. They feed, in warm weather, for three years, going down in winter to a greater or less depth according to circumstances, and at the end of the third summer go down to a depth stated to be two feet or more. Here they change to the perfect state, the Cockchafers making their appearance early in the following summer.

The grubs (from being buried down out of sight) are not as well known as they should be, for a sight of one accidentally turned up would often give the clue to the cause of much mischief. They are easily distinguishable by their large size when full grown, and their peculiar shape, figured at p. 18, the whitish fleshy body being swollen at the tail extremity into a kind of sack, usually of a bluish colour. They are also distinguishable by having three pairs of long brownish legs; the chestnut-coloured head is furnished with strong jaws. In common with some others of the Chafer grubs, they habitually lie, as figured, on one side.

In reply to some of my enquiries as to depth of the grubs beneath the surface, Mr. Wilson mentioned:—"On our Grass-land, which is being broken up, there is a lot of foggage, *i. e.*, old Grass which acts as a good protection from the frost. They have not been further down, and only now coming to the surface, because I find them always at the bottom of their burrow. As the land is ploughed at a uniform depth of five-and-a-half inches, we consequently see only those that are lying from five to six inches down. Those we do see would amount to a few hundreds per acre." In reference to some observations as to methods of clearing the grubs, Mr. Wilson remarked:—"We would not need to have pigs picking them up here, as the plough is almost always followed by crows, starlings, &c., which do not leave any grubs about. They (the grubs) have not sufficient vitality to re-bury themselves, as I left some on the surface over-night. I do not think they are very common about here. They occur chiefly in good land. As our land is a sandy loam on a gravel sub-soil, it is comparatively warm soil, and would, I imagine, thus be congenial to most forms of insect life. I could not assign any other reason for their occurrence, except that we are almost surrounded by woods of Scotch Fir."

This might very possibly be from the grubs feeding at the Fir roots. In 1882, I had notes of much harm being done to young seedling Firs by Cockchafer grubs removing the bark in large patches from the main root, and in the previous year "thousands of the Fir plants" at the locality had been destroyed. Another note was also sent me of very bad injury, at Eardiston, in Worcestershire, to a young Pine plantation, mostly Scotch Fir, from grubs of the common Cockchafer devouring the roots close to the collar.

In its perfect state, that is, as the Cockchafer Beetle, it does not appear to frequent the leafage of Coniferæ; it is noted in the 'Forst Zoologie' (Insecten), of Dr. Bernard Altum, that it will attack the Larches "not unwillingly," but spares the other kinds, with the exception of the male blossoms of the Pine, or Scotch Fir (" Kiefer"). For the most part the Cockchafers attack the leafage of the common forest trees, as Oak, Beech, Elm, &c., but, failing other food, they have been known to supply their needs from "vegetables." This would account for the grub having been reported to Mr. Wilson as present in Orkney, which, he observes, is "innocent of trees."

On asking Mr. England Wilson for the lowest temperatures, about the time when the Cockchafer grubs were turned out alive on the surface, he supplied me with the following readings. These were taken at the Dunecht Observatory Station (about four miles distance), at 9 a.m., from a minimum thermometer in a Louvre box about four feet above the ground, and were the lowest readings of the season :—

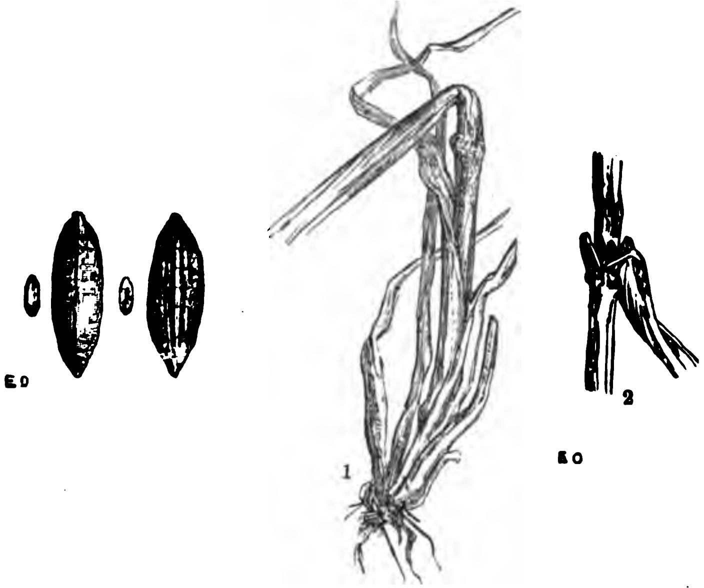
1890, Nov. 28th, 18·9°; Nov. 29th, 16·9°.
1891, Jan. 8th, 18·8°; Mar. 9th, 17·0°.

This of course does not give the precise temperature, either on the surface of the ground or at five to six inches below it, where the caterpillar was turned up from, but shows that they could stand a cold of approximately 18° of frost without being killed by it, so long as they were left in their own shelters; but when turned up to the surface, a fortnight or so after, then they had not vitality enough to make new shelters again in the ground.

Later on in the season, I had Cockchafer grubs and a surface caterpillar sent me from near Dorchester, by Mr. Arthur Edmondson, as examples of an attack which was then, the 23rd of September, doing mischief in a piece of white Turnips.

Such means of prevention and remedy as can be brought to bear have been previously entered on, but almost the only practicable plan for clearing the grubs appears to be ploughing, so as to turn them out on the surface. Thus in winter they may be killed (as above mentioned) in large numbers, or otherwise may be collected by children; or they may be killed by turning on pigs. But various kinds of wild birds are especially useful. Amongst these are rooks, the black-headed gull, and the common gull, and these should in no case be interfered with in their work. Of the "common gull" it is noted, in Yarrell's 'Brit. Birds,' that "this bird frequently goes some miles inland to follow a plough in search of insects and grubs." And of the black- or brown-headed gulls it is noted, in a quotation by the same writer relatively to their habits at their breeding-place at Scoulton Mere, in Norfolk, that "they spread themselves over the neighbouring country to the distance of several miles in search of food, following the plough as regularly as rooks, and, from the great quantity of worms and grubs which they devour, they render essential service to the farmer."

Hessian Fly. *Cecidomyia destructor*, Say.



1, Barley stem elbowed down by Hessian Fly attack; 2, showing position of "flax-seeds." Also "flax-seeds" or puparia, nat. size and magnified, showing the early and smooth, and the later or striated, condition.

During the past season very few observations were sent of presence of Hessian Fly, and none of it doing serious damage; and save to show how little we are suffering, in our insular climate, from this attack, which has the power of ranking amongst the worst Corn scourges in less favoured countries, it would be hardly worth while to mention it again.

The fullest return sent in was the following, with which I was favoured by Mr. Edw. Blundell, Prof. of Agriculture at the Royal Agricultural College, Cirencester. Mr. Blundell mentioned that during the vacation he had opportunities of visiting the harvest fields in many different counties, and had found the puparia of the Hessian Fly on the College Farm and in other parts of Gloucestershire. Also in Bedfordshire, where Prof. Blundell is still carrying on a farm; at Rothamsted; and near Welwyn, in Herts; and near Sevenoaks, in Kent, &c. But he further observed, "I am glad, however, to say it was only by careful searching that I was able to find them in some places, and they certainly have not been so prevalent as in some previous years."

Mr. Eardley Mason, writing from Alford, Lincolnshire, on the 21st of July, mentioned that Hessian Fly attack was much less abundant than in the previous year (1890), and that, though it was in every field, diligent search was required to find it.

Mr. D. D. Gibb, writing from Ossemsley Manor Farm, Lymington, Hants, on the 18th of July, mentioned:—"About a fortnight ago, I found puparia of Hessian Fly in Wheat plants, and to-day again came across one; evidently this attack is slight. As the puparia are mostly located at knots close to the ground, they are not easily distinguished; this would, I suppose, indicate attack at an early stage of growth in the plant.

Some other passing allusions to presence may have occurred during the season, though no report of damage, to a serious extent, having taken place in this country has reached me; but I give the following account (by favour of Mr. J. J. Willis, Superintendent of Sir J. Lawes' Experimental Grounds at Rothamsted) as an example of such virulence of attack, occurring no further from us than about twenty miles from the north coast of France, as to show other characteristics of presence beyond what are usually observable in this country.

With us, as we well know, the common form of attack is for the Hessian Fly to lay one or more eggs, a little above a knot in the Corn stem. The little maggots feed by drawing away the juices, without stirring from one spot, and consequently, where attack is severe, the weakened stem gives way, and elbows down just above the injured part, as figured at p. 21, and when examined the pest is usually to be found present, then advanced to what is called the "flax-seed" state, that is, a small, flat, brown chrysalis case, in shape and size much resembling a flax-seed (for figure of this, also see p. 21).

On the 10th of Sept., I received a large packet of French specimens, sent me on the part of Mons. Gabriel Eripier, as samples of a peculiar and injurious Wheat attack, of which the cause was not known, which was then occurring in the neighbourhood of Airaines, in the Department of Somme, in the north of France. On examination I found the specimens to be of stubble of a large-stemmed Wheat, having, in most instances, an unusual number of very thin shoots, from a few inches to a good many inches long, surrounding the base of the plants. In one instance, where the whole plant was sent as a specimen of the complete attack, I found, besides these spindly abortive shoots, the ear-bearing stem,—still of a very full green, but with the ear quite abortive,—long, very thin, and unable to free itself from the sheath, and the joint below much shortened, and round the base of this deep green stem were numbers of the abortive withered spindly shoots.

This green ear was described by Mons. Eripier as a characteristic of the attack. He observed, "There are some fields where about a third of the ears are quite green still, while two-thirds are ripe. The green ones are of a somewhat longer shape, so that at first sight they look as if they came from seeds of a different variety." Mons. Eripier suggested that this difference was to be ascribed to the retarded growth of the infested plants,—that is, to the injury caused by the larva,—the same being constantly found at the foot of the plants bearing the green ears.

The appearance of the plants was very peculiar, and at the first glance at the sheathed ear, and at the numerous shoots, suggested rather some form of "Gout" or *Chlorops* Fly attack above, and "Segging" or Tulip-root below, than Hessian Fly attack. The condition, however, appeared not at all unlike that described by Dr. Lindeman as occurring where the Corn is in bad condition, or where there are at one time such an extraordinary number of the Hessian Fly larvæ present that the infested plants die before they have formed their ears or reached their full growth. Dr. Lindeman notes, "I have observed such Rye and Wheat in Southern Russia, where nine stems from one root had perished before forming ears, and only one had reached to carrying an ear, and that of backward growth." *

On handling the plants sent me, I found that *puparia* (flax-seeds) of the Hessian Fly dropped from them; and I carefully examined the remains of the upright stems of stubble for specimens *in situ*. Here, however, I only found a single specimen, and that, curiously enough, was placed on the stem, *below*, not above, a knot. I then proceeded to examine the thin, short, or abortive shoots which were so numerous round the base of the stronger stems of some of the Wheat plants, and here I immediately found puparia at the lowest part of the shoots, which were plainly stunted by the presence of the infestation.

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* Die Hessenfliege (*Cecidomyia destructor*, Say), in Russland, von Dr. K. Lindeman, Moscow, 1887.

The flax-seeds were usually covered by the sheathing leaf, but were easily to be found on careful examination, as, from the stunted and small size of the stems (irrespective of their length), the slight lump caused by the presence of the "flax-seed" was noticeable as bulging out beneath the thin leaf in a way which would not have been observed on a moderately well-developed stem. These stems were so thin that there was very little room for numbers on one stalk, but I found quantities of stalks infested by one or two, and in one case by three, flax-seeds. The infestation was mainly (if not entirely) at the bottom, or near the bottom, of the stems.

The "flax-seeds" corresponded with our English specimens in size, shape, and colour; they were just the same tint of brown, and the little pinch-in near one end (as if a nail had been pressed on the chrysalis case) was clearly noticeable. On removing the contents of one "flax-seed" case which was not much advanced, I found that the maggot within was clearly that of a *Cecidomyia*, by reason of it possessing an "anchor-process," or breast-bone as it is sometimes called, which is one characteristic of Cecidomyideous larvæ, and, on further examination, the free extremity of this minute process, which lies beneath the body of the larva at the head end, quite *precisely* accorded, in its bifid shape, with that of the larva of the Hessian Fly, the *Cecidomyia destructor*.

I have entered on the description of this unusual form of effects of Hessian Fly on the attacked plants at some length, as (though extra British) a locality about half-way between Paris and Calais is not very far from our own shores, and without careful examination the plants affected, as above mentioned, might so easily be passed by as suffering from some other attack, that it can do no harm to notice this form of neighbouring Continental development.

We are well acquainted here with the very best methods of prevention and remedy, but in the above case, as it was of great importance to stamp out a previously unobserved attack, and also difference in climate might allow different measures to be brought to bear, I suggested that, if possible, it would be desirable to fire the stubbles of the attacked fields, and so *stamp out* the infestation without delay.*

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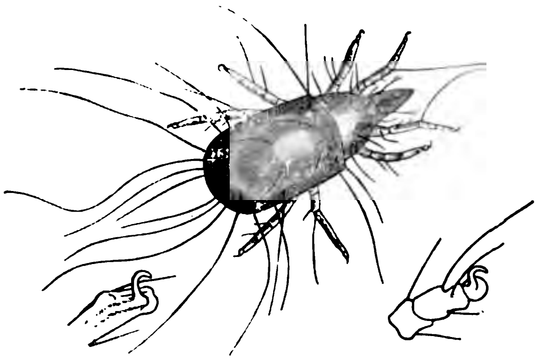
* By permission of Mr. J. J. Willis, through whose hands the infested plants were forwarded to me, I gave a description of this attack in the 'Agricultural Gazette' for Sept. 21st, a portion of which description is repeated above.

Mites (in Hay). *Tyroglyphus longior*, Gervais.



TYROGLYPHUS LONGIOR.

T. longior (from fig. by Fumoze and Robin): claw and sucker of *Tyroglyphus*, right-hand side (from Murray's 'Aptera'); claw and sucker on left-hand side, figured by ED. from life: all magnified. Nat. length rather more than half the 25th of an inch.

The presence of Mites in hay continues to be reported, and (though probably only from attention being drawn to the subject) more so than in previous years, and, as regards their presence in stacks, up to the 6th of November we seemed to be as far as ever from knowing why they are there, or how to get rid of them. Then, however, some very noteworthy information was forwarded by Mr. Thos. Fraser, of Ardfin, Isle of Jura, N.B., showing that the Mites are first observable in the fields beneath the haycocks or tramps. This is a very important clue to the original locality of the infestation, and I give Mr. Fraser's notes *in extenso* at pp. 29, 30. Some other information, also, we have gained; the attack is nothing new, having been noticed as much as some five-and-twenty years ago; it is wide-spread, as observations of its presence are given in Scotland, at localities respectively in Berwickshire, Aberdeenshire, and the Island of Jura; in England, in Yorkshire, and Cheshire; and it is rather curious, though very likely only a coincidence, that most of the localities are on, or near, the sea coast. Also it is observable that it is not reported from the more southerly parts of England, and some of the observers notice the infestation as being found in hay which has been well saved, but not heated. In some cases, where the kind of hay infested is noticed, this is named as Rye-grass, not meadow hay; also we have notes of the Mites disappearing from round the stacks with the arrival of cold, wet weather in autumn, and also, where infested hay was stored in lofts, of the creatures dropping in the succeeding summer from the previous year's hay.

These respectively indoor and out-of-door observations may give us some clue to prevention, otherwise we have made no advance in this direction. We have, however, notes that, excepting annoyance to horses from the Mites in infested fodder causing coughing by reason of the tickling in their throats, otherwise no harm at all has been observed as caused by their presence; and it will be noticed, in the communications by Mr. Colin Campbell, that relatively to this point he especially mentions that Mite-infested hay was fed to a large fold of in-calf cows, young cattle, horses, and dairy stock, without doing them the slightest harm.

This cannot be considered as an important attack; still it to some degree lessens the value of the hay, and in every way we should be much better without it; therefore I give the observations of the past season, from which the above summary has been taken, hoping that they may lead to further notes of how to prevent infestation, or clear Mite presence from the fodder.

These little "Mites," or *Acari*, are quite indistinguishable, without strong magnifying powers, from the common Cheese Mites, which may constantly be seen lying in little heaps, like greyish or yellowish powder, where they have fallen, on a dish or on dairy shelves, from infested cheese; only, in the case of the Hay Mites, they may be found in great masses round the stacks, or dropping from the infested hayloft.

The figure of this Mite (magnified) at p. 25 gives its general appearance, with its crab claw-like jaws, and also with the long hairs which are one means of distinguishing it from the nearly allied "Common Cheese Mite" (*Tyroglyphus siro*), and also the single claw and sucker at the end of the foot, which is a characteristic of this sub-genus of *Acarina*, or "Mites," namely, the *Tyroglyphi*. It is almost impossible, however, for any one who has not made a special study of these minute creatures to identify them from mere description; therefore when first brought forward, in 1886, we obtained a trustworthy identification by Mr. Albert Michael, and since then such of the consignments of Mites as I have examined microscopically have agreed with those first noticed, and the most observable points, which can be seen by fairly high microscopic powers, are given in my preceding (14th) Report.

Early in April, Mr. J. England Wilson, writing from Springhill, Skene, Aberdeenshire, forwarded me, accompanying, "a sample of Mites with seed taken from the floor of a hayloft." He noted:—"The hay is Rye-grass and Clover, well seasoned but not heated in stack. It possesses no perceptible odour. Horses eat it, but cough very much, owing no doubt to the Mites irritating the windpipe."

About the same date Mr. David Byrd, writing from Bunbury Heath, Tarporley, Cheshire, mentioned:—"The Mites in hay we have long observed." . . . . "We also find them in our granary. When the

Corn is removed and the floor swept, we very shortly find a gathering like a handful of dust on different parts of the floor. Mites, if neglected, will very soon lessen the value of cheese by losing its brightness, but in hay the mischief may not be so easily seen; they may to some extent destroy the aroma which good hay should have."

The following note of enquiry, forwarded to me by the Editor of the 'Farming World,' also speaks of the Mites being found in a loft as well as in the stacked hay, and in this case in Clover hay. The note was as follows:—"A few weeks ago I bought from a neighbouring farmer ten tons of what I thought to be good Clover hay. It was brought home, and part was made into a stack, the other part being put into the stable loft. The hay is now living with Mites, and I wish to know if, when eaten in such a state by horses and cattle, it will prove injurious to them?"

The following note, which I am permitted by the observer to use, though not originally sent to myself, was written on Sept. 15th, and notices the great quantity of what proved, on examination, to be the same kind of Mites found on the ground or straying about by a haystack:—"I was at a place in Berwickshire last week, and at lunch we leaned our guns against a haystack. On lifting them we found them powdered with white Mites, and on looking at the foot of the stack we found the ground covered with a thick powder of the Mites, which had evidently dropped from the stack. No one of the party had ever seen such a thing before, nor had any of the farm servants. I send you a tin with some of the Mites, and will be obliged if you will tell me if you have seen anything of the kind before, and if so what they are, what has caused them, and if they are likely to be injurious."

In this instance the Mites were presumably in the substance of the stack, for in a subsequent letter my correspondent remarked, "The farm bailiff mentioned that when cutting the hay the men had complained of it being full of lice." As this word is by no means limited popularly to its technical meaning, in all probability it was used in this case in reference to the Mites.

Notes came from other places, as for instance, an application, with specimens accompanying, from Upleatham, in Yorkshire, mentioning the Mites as being picked up close by a haystack, and desiring information as to what they were. Also, on the 25th of Sept., Mr. John Speir, of Newton, near Glasgow, writing to the 'Farming World,' in reply to some of my enquiries, gave the following observations:—"No one need annoy himself about having Mites in his hay, as it is only well-saved hay which produces Mites. I have seen them an inch or more deep on the ground round a hayrick, but as soon as the cold or wet weather sets in they all disappear. This is the most commonsense way of clearing them off, which Miss Ormerod asks about, that

I know of, and I certainly never saw Mites in hay in October or later, and in most years they disappear very much earlier."

The following notes, with which I was favoured by Mr. Colin Campbell, of Jura, N.B., also point to method of saving the hay having an effect on the amount of Mite presence, and also (together with some other observations) to the infestation being most noticed in Rye-grass hay; and further show that this infestation is one of long standing. Mr. Colin Campbell, writing on the 30th of Sept., remarked:—"With regard to Cheese Mites in hay," . . . . "I see them every year in the Rye-grass hay in Jura, and they do stock *no harm* whatever. I see Mr. Speir, in 'Farming World,' states they disappear when the cold weather sets in; I can't say as to this, but if so they certainly reappear in summer again, as I noticed them falling on to the heads of the horses from the lofts above, and that was last year's hay. I have never noticed the Mites in meadow hay, but of course they might be present."

Mr. Campbell also wrote me, a few days later, relatively (amongst other points) to this attack being most prevalent in the more northerly parts of the island:—"There is no doubt that it is more of a northern infestation, and in Scotland it is not the practice to allow hay to heat, which may account for them being present. It is generally the case that good well-saved hay is most infested. I enclose a cutting of the letter I addressed to 'Agricultural Gazette' after reading your Report of 1890." This was as follows:—

"Mites in hay.—Some five-and-twenty years ago, when a lad going about the home farm at Jura, N.B., I often used to wonder at the quantity of light-coloured, dusty-looking material, that used to drop on the window sills of a large hay-barn (stone and slated), which was fitted with windows and louvre boards, and often in passing I used to disturb it with my stick or hand, and was always puzzled on finding that when next I passed the mass appeared level again and my marks obliterated. One day I made a small heap of it, and then noticed for the first time that it moved about and was a mass of insect life, corresponding with the Mite mentioned in Miss Ormerod's last Report on Injurious Insects, &c. The hay stored in this barn was always first and second year's Rye-grass hay, which never heated, as it was allowed to stand a considerable time in tramp ricks in the field to season, as it had to go into this built barn. The Mites appeared to me to give off a sweet smell, rather like honey.

"I have never noticed these Mites in meadow hay, of which a quantity was stored in other lofts, but they may have been present without attracting my attention.

"For the information of your readers I may state that this hay was fed to a large fold of in-calf Highland cows, young cattle, horses, and dairy stock, without doing them the slightest harm or producing any ill-effects."—From 'Agricultural Gazette' for March 23rd, 1891.

The following notes, with which I was favoured on the 6th of Nov., by Mr. Thos. Fraser, from Ardfin, Isle of Jura, N.B., are well worth careful perusal. It will be seen that the Mites are found under the "tramps" or "cocks" in the field. This shows the locality of the Mites as being in the Grass field; and Mr. Fraser's belief that the Mites are at this time smaller than later in the season, points to them being then not long hatched; for later on, when I have had them from haystacks or lofts, there have been large and small (old and young) together. Looking at the fact of the very nearly allied Cheese Mite, the *Tyroglyphus siro*, being also a feeder on flour, there seems no reason against this species of *Tyroglyphus*, also a Cheese Mite, feeding, as Mr. Fraser suggests, on the seeds or on the anther dust of the Grass blossoms. Also, as I suggested (page 45 of my 14th Report), these Mites do not seem entirely at home *in* the artificial situations of haystacks or lofts, as they are commonly reported as in great quantities outside, "even to being dropping by shovelfuls." The attack having now been traced so far on towards its source, it may be hoped that in the coming year a little investigation in the field (magnifier in hand) may complete the life-history. Mr. Fraser wrote me as follows :—

"It is the general practice in hay-making in the West of Scotland (West Highlands), as soon as possible after cutting or mowing (which ranges from the end of June to the end of August), to have the hay collected in large tramps or cocks on the field, where it is allowed to remain for some time. The first appearance of the Mites (to an ordinary observer) are when removing the said cocks or tramps from the field. While forking the hay from the bottom or lower part of the cock on to a cart, at a much higher elevation, it is necessary to raise the hay *overhead*, and in minute particles, like dust, the Mites fall, and, from the backward position of the worker's head at the time, they stick or adhere to the face in a very short time, causing itchiness or irritation on the skin. At this stage, I think, they are less in size than they are when found, a fortnight or so later on, emerging from the recently made stacks. A certain amount of moisture or damp in the hay (more so in a wet or moist climate, such as along the Atlantic seaboard), as we have in the *west*, causes a perspiration or sweating, or perhaps heating in the hay, and this may to a certain extent be the reason why the Mites, being uncomfortable, make their exit to the outside of the heap or stack as the case may be. One remarkable thing is, that they can move along or extend themselves on an *even* surface, or wooden floor, for a considerable distance, somewhat in the way the honey-bees do against the hive before swarming, only that they differ inasmuch that they do not appear to have the power of suspending themselves as the bees do. But when they extend (*i. e.*, the Mites), they do so in a *continuous* mass, sometimes several feet outwards.

"They have been in Rye-grass and in meadow Grass this season, but more abundant in the former. During the month of September and early part of October they showed, or appeared to be, at their greatest strength and activity; after the middle of October they gradually showed less vitality and power to move or extend, until now (the beginning of November) all life is apparently gone, and the mass of the once living organism has shrunk into less than one-half its original size.

"I cannot say, but the probability is, that the Mites are nourished or sustained on the heads or seeds of the hay. And the fact that they are to be found more abundant in Rye-grass seems to strengthen this argument or idea, as the powdery anthers are more prolific or profuse on this Grass than on meadow Grasses.

"In appearance and colour they closely resemble the Cheese Mite. They are to be met with in the North of Scotland, but not nearly to the same extent as in the west, where the climate is much warmer and moister, the north being colder but much drier."

PREVENTION AND REMEDIES.—In lofts where hay is commonly stored, it would be desirable, after a supply has been finished, and Mites are found to be so numerous that (as noted by Mr. Byrd) they can be swept into little heaps, to have a thorough cleaning. A complete sweeping together first, from all accessible places, whether floor, or walls, or rafters, or any other parts, and especially the darkest and most sheltered spots, and burning the collected masses, would be well to begin with. This, if followed up by washing down with scalding water, application of soft-soap wash (all the better for just a little paraffin oil in it), and such applications as whitewashing walls, tarring rafters, &c., could not fail to tend very much against reappearance of the attack indoors.

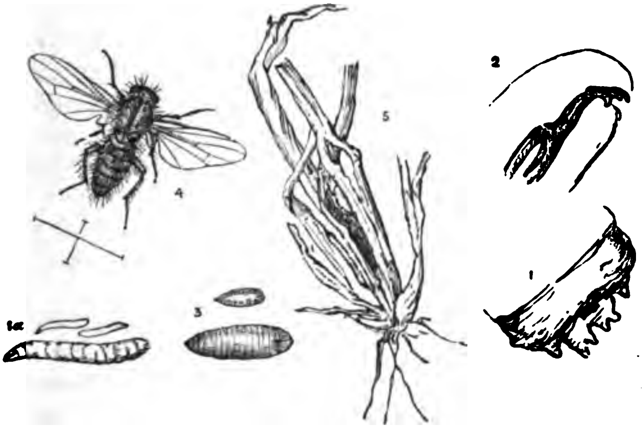
Out-of-doors, we need to know how and when they get into the stacks. We have no observations of the infestation being in the Grass when *being* saved; that is, nothing to connect the infestation with being brought from the fields, in the seed-heads of the Grass or otherwise. We have it noticed as brought with hay, or being present in, or rather as dropping from, hay; and it occurs whether, in these instances, the Mites may not have taken up their quarters in the rubbish which may often be left, year after year, on the site where one stack after another is placed, and so infest the new hay.

Where stacks are placed on any foundation which can harbour Mite-vermin, especially of rough wood and logs which allow much old hay to slip down amongst them, it would be well for the owner or a superintendent to examine into the state of this footing, before a new stack is built on the site of an infested one, and attending to the state of the case as circumstances directed.

In the south-west of Gloucestershire, where for a long series of years I constantly saw the haystacks on the family property, I cannot remember ever seeing or hearing of this attack either on the home farm or those of the tenants, and there the hay was customarily much more liable to be over- than under-heated, this up to danger of firing, as shown by the stacks having, as no uncommon thing, to be partially unmade to cool, or by the black colour (showing a scorch had occurred) when cut for use.

Common-sense measures, such as throwing quick-lime or gas-lime, or running a band of tar on the ground, or some waste material round the stacks, from which the Mites drop in great quantities, suggest themselves. The Mites would thus be prevented straying about in legions to continue infestation; but in the light of the information received when these pages were passing through press, it may turn out that (if thought worth while) measures may be taken in the field towards preventing transit of Mites to the stack.

Wheat-bulb Fly. *Hylemyia coarctata*, Fallen.



Wheat-bulb Fly (*Hylemyia coarctata*), magnified, and lines showing nat. size; maggots and chrysalids, nat. size and mag.; mouth apparatus, and extremity of tail, with tubercles, mag.; infested plant.

The only one of our commonly observable Wheat- and Barley-stem attacks which has very noticeably held its ground during the past season (that is, so far as is shown by amount of observations forwarded) is that of Wheat-bulb maggot. Corn Sawfly was not noticed as troublesome, and *Chlorops* or Gout Fly was little reported, although, from notes placed in my hands by Mr. Edw. Blundell, Professor of Agriculture at the Royal Agricultural College, Cirencester, the Gout Fly appears to have done considerable damage to Barley in some localities.

The Wheat-bulb maggot, however, was very noticeably present, as enquiries regarding the attack began towards the end of April, were forward on seventeen days of May, and continued to some slight extent into June. The localities written from regarding the attack were, with the exception of Gloucestershire, on the easterly side of England, namely, from Essex, Bedfordshire, Cambridgeshire, Lincolnshire, and Durham.

The following observations will be found to confirm those of preceding years, as to the attack of Wheat-bulb maggot being customarily found (where it occurs at all) on land which has been fallowed, or otherwise much exposed to the sun, in the preceding summer. Details of various points are also given by various observers, which, by collating them together, appear to point strongly to this attack being set on foot by maggots from eggs deposited before the time of autumn Wheat-sowing on the exposed land. These points are brought forward for consideration together, in the "summary" following the observers' notes.

On the 28th of April specimens of infested Wheat were sent me from Cottenham, Cambs., with the remark, by Mr. Robt. Norman, the sender, that he had known hundreds of acres ruined by the maggot. On the same day also specimens were sent by Mr. J. Hunt from Coton, as being of an attack previously unknown in the district, and that the maggots "entirely destroy the plant, and leave the field bare."

On the 5th of May, Miss M. F. Curtis Hayward, writing from Quedgeley, near Gloucester, observed of this same attack:—"We have a field of Wheat that has failed, and died off after coming up at first strong and well. The stems, a little way above the root, appear to have decayed, as if they had been attacked by some pest." The grub taken from one of these stems, and sent as a sample, proved to be of the *H. coarctata*, and a few days later Miss Curtis Hayward further noted:—"Since writing, we have heard of several instances, in the neighbourhood, of Wheat attacked in the same way as our own, and no doubt by the Wheat-bulb maggot. One farmer has lost ten acres out of forty."

The following note, sent me on the 18th of May, by Mr. S. G. Jones, from Hatherleigh Court, near Gloucester, is of much interest; first, in showing that we are in no way benefited by the severe cold of last winter in getting rid of these maggots; and next, in confirming previous observation as to the great influence exercised by previous state of the ground, or even slight difference of locality, or method of treatment at the time of putting in the seed, on presence of this kind of maggot attack. Mr. S. G. Jones wrote as follows:—

"I send you sample of Wheat plants, taken out of the ground to-day, from ten acres sown on the 10th October, after bare fallow. Before the hard frost, the crop was up and looked well, and early in February, just before the second heavy fall of snow, a good dressing of soot was applied. The same seed was planted on the same day on adjoining land, but following Beans, and is now a very strong crop. The extraordinary thing about this ten acres is, that round the 'headlands,' where the seed was drilled in the opposite direction, there is a *good crop now*. The good crop forms a sort of frame, and where the picture should be the crop has entirely gone off, as per sample sent, except just in the furrows at the lower end of the piece."

The following notes by Mr. Robt. Norman, previously quoted, also turn (after the first observations) on the effect of state of ground, or of method of cultivation, on amount of attack. Mr. Norman mentioned, with regard to the maggot, that this "I have unfortunately been acquainted with for many years, to my cost, and am able to tell very early in the season when the crop is attacked." Further, Mr. Norman observed, regarding the maggots:—"After a fallow, on land with which I am acquainted, the Wheat almost invariably 'goes off' by them; also where the land is stirred, by ploughing, scarifying, or harrowing, during the months of September and October, it appears to propagate them. I could give instances where land lying contiguous has not been stirred, and the plant has escaped the attack."

The following observations, from Mr. Wm. C. Gardiner, of Little Yeldham Hall, near Halstead, Essex, note the extent of mischief caused by the maggot by April 30th, the date of the first note; the second adds one more to the many previous observations of appearance of this infestation after fallow. Mr. Gardiner wrote:—

"I take the liberty of sending you specimens of maggots or grubs which are devouring my Wheat plant, and are quite different from any kind of insect that I have known to prey on the young Wheat. Before, I had a full plant all over the field a month ago; and where the maggot is at work, it has wasted quite 50 per cent, and is still going."

On May 9th Mr. Gardiner wrote:—"I may say that the preparation for Wheat was, Red Clover a full plant at first, but it gradually died off; so folded it with sheep, and broke the land about July. Being clean I did not touch it any more till October, when I planted the seed. It being a very warm September and autumn, I can quite understand the land being in a favourable condition for the fly to lay its eggs under the furrows."

The following report,* sent on May 8th, by Mr. William Sewell, of Tillingham, Southminster, Essex, also mentions great damage, and prevalence of the attack after fallow:—"The last three years we have had a maggot eating our Wheat in these parts, and this year it is doing more harm than ever, many of the Wheats being so bad that they have to be ploughed up in some cases, and patched with Oats in many others. The maggot, of which I enclose specimens, lives in the heart of the stem of the Wheat, eating it completely out, and then going on to another piece, making the Wheat, where there was originally a very good plant and looking very well, almost completely disappear. It seems to appear in the Wheat about the beginning of April or end of March, and to attack Wheat, particularly, grown on whole fallows. Where winter Tares are fed off, and then the fallow is made, they are bad, but not quite so much as on a whole fallow; and where spring Tares are fed off later still, they are less harmful. Also, on Clover layers (one crop cut, and then broken up) they are the same as on Tares fed, and Pea-etches sown with Wheat seem a favourite place for them, but Bean-etch Wheat seems quite free."

About the same date, that is, on or just before May 8th, Mr. G. W. Sanders wrote me from Church End, Haynes, Bedford, mentioning:—"Several of the Wheat crops in this neighbourhood have been dying off during the past month. On examination we find it is caused by a small worm in the stem near the root." Specimens were sent, as well as infested plants, in which some of the maggots were fairly full-grown; and in reply to my letter on the subject, Mr. Sanders noted that "all the fields where the Wheat has gone off are after fallow, both on my own and neighbours."

Mr. J. Alex. Henman, on the 18th of May, sent me specimens of the maggot from Bromham Grange, Bedford, as samples of an attack which was destroying his Wheat plants; and a few days later, like other observers, noticed it as worst after fallow, and also as *not* having extended to the more solid headlands. He observed:—"On the portion of the field where the attack is the worst, there was no crop last year; it was a dead fallow. The attack has not extended to the headlands, which, from being trod in ploughing, were more solid; also two pieces in the same field were Mangold Wurzles last year, and ten cwt. of superphosphate of lime was sown to the acre; on these two pieces the Wheat plant was very vigorous and healthy, without any sign of the maggot; even the outside rows are not touched."

Mr. Henman further observed, relatively to pressure of the ground:—"It is a good plan, if fallow is sown with Wheat, to put on a good heavy Cambridge roller at the time of sowing, but often, as in my case last year, the land was not sufficiently dry, and it could not be done. Fallow is undoubtedly best sown with Oats or Barley."

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* I beg to acknowledge, with thanks, this report, as being forwarded to me by the Editor of the 'Field.' It is given at p. 742 of the number of the 'Field' for May 16th, 1891.

Mr. W. Creese, of Teddington, near Tewkesbury, who has had long experience of this pest, favoured me with the following observation, which, it will be seen, turns still on the point of the grub following fallow; and in the very same field, and after the very same crop, attack *not* occurring where this preceding crop had been kept on late, so that the ground was protected by it and not fallowed. Mr. Creese remarked:—"When walking over a neighbour's farm, I saw that two sides of a field had failed from the grub. The land had been skimmed, and planted again with April Wheat. A few acres in the middle of the field were spared, and promise a heavy crop. The explanation given me was that the vetches on this portion were kept for seed, and the land was ploughed late, instead of being, as, on the other parts, mown early and the land summer-fallowed."

The following note is still on the same lines of the attack occurring where land has been greatly exposed, even where not actually fallowed, and this also we have had evidence of in previous years. Mr. W. Wiles Green, of the Elms, Manea, Cambs., writing on the 16th of May, mentioned:—"The Wheat-bulb maggot has, I think, now done its worst, and, I am sorry to say, has in many instances left us but a poor patchy crop. The injury, I may say, in most or all cases, is to the Wheat crop sown after Oats." . . . . "My opinion is that the mischief was done after the Oats were cut. It will be in your remembrance that the latter end of August, and for some time then, the weather was very hot and fine, and the Oat crop, being a heavy one, had to be mown very close, leaving the land in some places quite bare."

Mr. Wiles Green further wrote:—"You say, in reference to the attack, that part of some fields only are attacked. I know several cases, this year, where part of the field was sown or planted with Potatoes, and the rest with Oats. The Wheat after Potato is a very fine crop; after Oats, a very thin, patchy one; and the difference is so sharply defined you can see (one may say) to an inch." Also, the remark, "I am somewhat afraid the only remedy we have is not to sow Wheat on land that has the July or August sun shining on it," appears at present only too near the real state of the case.

But (resuming the past season's report) on the 21st of May, Mr. Eardley Mason, of the Sycamores, Alford, Lincs., sent me observations of three attacks in the neighbourhood of Alford. In one at Willoughby, the attack, examined on the 17th May, was then advanced to the pupal or chrysalis state, and a full third of the plants were estimated to have been destroyed. This crop was after a fallow. On the following day, the 18th, in a field at Cumberworth, some of the pests were still to be found in maggot state, nearly and quite full fed, as well as puparia. Here, again, a third of the crop was considered to be destroyed. This attack was after *mown* Clover, and the crop sown the first week in November, 1890.

A third attack was reported from Helsey on the 19th, but not examined, as the damaged crop had been ploughed up. The previous rotation had been:—1889, Oats; 1890, fallow, crop sown 1st Nov.; 1891, resown with Barley 8th May.

Mr. Eardley Mason added the very noteworthy observation that in all the cases the headlands were not at all, or very slightly, affected.

The following observations, also, by Mr. E. Mason, are of practical value, as showing no *noticeable* presence of the attack in wild Grasses. The remarks as to non-presence of the attack in wild Grasses were in reply to my own inquiries, turning on the point of some of our Corn insect-pests being double-brooded; and that in this case, if, like the "Frit Fly" in Oats and Barley, the spring attack took place in the young shooting plant, and the summer one in the ear, we should thus gain a good clue towards prevention. I suggested Grasses, as these might be found on neglected fallows, or in the noticeably thin crops sometimes preceding Wheat-bulb maggot attack.

Mr. Eardley Mason wrote me on the 24th of May:—"I doubt much whether *H. coarctata* will be found to have a summer brood. The larva is so large that I can scarce believe that the damage caused by the summer-born host could have escaped notice. For the last three years my eyes have been at work detecting injured Grasses in hedgerows and by roadsides. With scarce an exception the cases have been of fungoid disease. In no case has there been an approach to injury like that of *H. coarctata*.

Further on Mr. Mason notes that "It is true that the headlands get the most trampling, and are thereby consolidated; and if it should be the case that the fly lays its eggs in the broken-up soil before sowing, one can understand how many eggs must be so closely compacted as to render the emergence of the larvæ impracticable." . . . . "If the fly lays its eggs in spring, I wholly fail to understand why headlands, and Wheat after seeds, escape."

The following observations were kindly sent me by Mr. William Parlour, of Middle Farm, Dalton-on-Tees, Darlington, regarding some points on which I enquired of him, especially those suggested by the absence of attack on trampled or "firmed" ground, as on headlands. The first observation is as to infestation in spring-sown Wheat:— "I have never known of the maggot being found in spring-sown Wheat, but I have had very little opportunity of observing, for the quantity of Wheat sown in the spring in this district is very small indeed."

The second observation gives some remarks on rolling, and also on there being possibly some confusion between effects of maggot and of frost on the young plant; and this point is also alluded to in the communication by Mr. E. A. Fitch, given below.

Mr. Parlour observed:—"With regard to your second question, it is not usual to roll land in autumn, and I have never known an instance of it; but, rather strangely, I find on enquiries that it was the universal custom fifty years ago to roll fallow land in the autumn, after it was sown with Wheat. The reason given for this custom was that it prevented the Wheat from being 'turned out' by the frost. Now as to this 'turning out:' I have visited many fields that were said to have been 'turned out,' but I found *in every instance* that it was the maggot, and not the frost, that had done the damage. I do not say there is no turning out because of frost, but there is not nearly so much as is generally ascribed to it. Is the foregoing sufficiently connected to enable us to come to the conclusion that the pest was in existence fifty years ago, and rolling in the autumn was resorted to, to prevent it? Scarcely, perhaps; it would be going too fast; but it is as well to keep this in mind for a time."

The following notes, from Mr. E. A. Fitch, of the Brick House, Maldon, Essex, refer to various of the foregoing points, and are of some special interest regarding technical insect observation, as, besides being an agriculturist on a large scale, Mr. Fitch is an entomologist of old standing, and was at one time Secretary of the Entomological Society. Mr. Fitch wrote me on the 9th of June:—"This white maggot has been very troublesome on our Essex heavy land this year, and much that has been said to be winter-killed has, I believe, really suffered from this pest. Mr. Frank Page had twenty acres of Tare-etch Wheat; the Tares had been fed off, and where the field was first folded, and consequently first ploughed and longest fallowed, the attack was very bad, and in less intensity over the field, until the side sown with spring Tares, and only ploughed for Wheat once, not fallowed at all, was hardly touched. The rest had eventually all to be ploughed up, and in the earliest ploughed (last year) land hardly a blade was left. This is interesting, and looks as if the tilth of the land had something to do with it; it is always worst on fallow or Tare-etch Wheats than on Wheat after Beans, Peas, or Clover. I have enquired, and there are no changes in rolling practice; we have never rolled our Wheats except in spring, or, for the matter of that, any other land."

Summary.—Looking now over the notes of the past season, in connection with those of previous years, it seems to me that though we have not advanced to certain knowledge (that is, knowledge from absolute observation of the maggot itself in the ground) of where the infestation lies in autumn, or how it begins its attack on the young Wheat, yet that we have got a strong clue.

The point which we have wanted to make out throughout the years of observation has been, *is there a summer brood?* It appeared against all likelihood, and contrary to all common insect habits, that the flies, that came out in July or earlier, should remain alive and without egg-laying until the time of the sprouting of the autumn or early winter-sown Corn. Therefore we needed to ascertain whether there was a second brood, of which the flies came out in autumn, in time to lay eggs by the young Wheat. Failing these, there appears to be no possible cause for this bad infestation, excepting the presence in the ground (in autumn or winter) of eggs, or of maggots hatched from eggs, deposited by the flies which we know come out about July. This, it appears to me, from collation of observations, *must be the case.* We can put the matter to practical proof presently, but meanwhile I think it will be considered, from the following observations, that any other method of infestation appears, so far as our information up to date goes, *most unlikely.*

First, about non-observation of second brood. In Mr. J. Eardley Mason's notes (p. 86) we have the report of a pratised observer, and one well acquainted with Wheat-bulb maggot attack, who, though carefully watching the condition of Grasses for several years in a Wheat-bulb fly infested district, yet never saw, amongst the various forms of disease which he noted, any instance of presence of this attack, namely, that of the *Hylemyia coarctata.* No one has ever reported it in this country (or, as far as I am aware, any where else) as being found in any part of the summer and autumn Wheat, or other Corn crops, and therefore, if it is unknown both in Corn and common Grasses in the summer (meaning by this the later part of the summer after the first brood has come out of the ruined spring plant), this gives a very strong presumption that a second or summer brood does not exist. Therefore, that autumn attack is set on foot not by *flies* laying their eggs on the young sprouting Wheat, but by *maggots* hatched from eggs laid in the ground earlier in the year.

This view is confirmed by the very peculiar customary limitation of the area of attack to land which in the previous summer has been under special conditions. It is very well known that where maggot attack occurs it is usually after fallow, or on land that has been much exposed to the sun. But besides the broad-scale observation of this, as in whole fields, or fields of a whole district, it may be shown as occurring almost to a line in portions of fields. We can point to small *attacked* patches where ground was left bare by failure in a previous crop; again, we can point to a strip across a field being *free from attack* where this part was *protected* by a crop which was ploughed late, whilst there was an attacked part on each side where the crop had been removed early and the ground summer-fallowed. Also, in the very useful note given by Mr. E. A. Fitch, we have an account of a twenty-acre field of Tares, which was fed off, and on the part where the land was first folded and ploughed, and therefore longest fallowed, the attack was very bad, but went on over the field with less intensity, until, on the side not fallowed at all, the maggot hardly did any harm (see p. 87).

All these observations seem to point strongly to the attack on the young sprouting Wheat not being from the fly laying eggs on it, but from maggot in the ground. It seems beyond all probability, or anything that we have precedent for, to suppose that in a field of Wheat, of which the whole was sown at the same time and under similar conditions, the *flies* would leave or choose portions, almost to marked lines, where the whole crop would serve them equally for food.

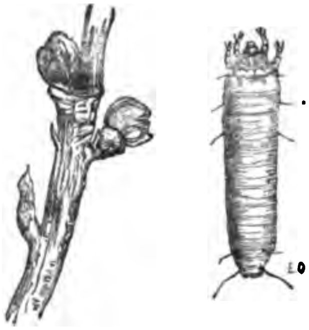
But with the maggot the matter is quite different. If the eggs were laid on the exposed land, or not laid on the protected land, there (accordingly) would be presence or absence of maggots, and we thus appear to me to reach to the probable explanation of cause of attack.

The non-appearance of the infestation on the trampled headlands, as observed by several correspondents, points in the same direction. In case of the fly laying her eggs *subsequently to ploughing*, there does not appear to be any reason why the attack should be worse here than in the field. But if the eggs, or the maggots, were there, the trampling and compacting the soil might be well believed to lessen their amount.

Whether the above views are the correct ones remains to be proved, but these alone would explain the peculiarities of the attack, which have long been well known, and would reconcile all the conflicting points. One of the best methods of proving the views which occurs at present, would perhaps be ploughing with skim-coulter, attached so as to turn down the uppermost (and probably maggot or egg-infested) surface, and bury it well away beneath the deeper land slice, which would be laid on the top. This might easily be tried first on a small scale, say on an acre or so, where there was likelihood of infestation being found; and if absence of attack followed in an otherwise infested field, we should have gained most useful information. At present our only really well-founded hope of escaping infestation, in districts where the attack is commonly prevalent, appears to be not sowing Wheat after summer fallow; but if the maggot proves to be in the ground, then the way would at once be open to prevention of attack by various forms of dressings, or ploughings, or, in some instances, where nature of the soil allowed, by rolling or sheep-treading to compact the soil.

CURRANT.

Black Currant Gall-Mite. *Phytoptus ribis*, Westwood.



Phytoptus infested buds; *Phytoptus* (? sp.), enormously magnified.

The attack of the Black Currant Gall-Mite was again reported as occurring at various localities in the early part of the year, from February, when the buds were first beginning to show the peculiar swelled growth which distinguishes those attacked by the Mite from the natural form, up to the middle of April or beginning of May, when the work was in progress of removing the "galled" buds from the infested shoots. These round diseased masses of abortive growth, like small balls of green leaf-scales, may be about the size figured above, but often twice that size or more, and on opening them they will be found to contain (probably in great numbers) the minute "Gall-Mite" which has caused their growth. This is too small to be discernible by the unassisted eye, but with magnifying powers will be seen to be of the long narrow cylindrical shape figured above. It is furnished, throughout its life, with two pairs of legs, placed near the head extremity. This, it will be seen, is a little enlarged before it narrows rapidly into the somewhat snout-like or bluntly pointed proboscis. The Mite is also furnished with a few long bristles, and is hatched from an egg.

This attack has been so frequently alluded to, that it seems unnecessary to repeat the descriptions of the attack sent in from different localities during last season; but it may be observed that the infestation is one which is troublesome and wasteful enough, even on the small scale of private Currant growing, but where this is multiplied by acres, as in the regular Currant plantations, the losses, consequently on failure of crop first, and afterwards from injury to the health of bushes of which the leafage is thus checked in development, are very serious. The attack is now widespread, and is certainly to be found at localities from Devon to near Glasgow, and possibly further north.

On the 16th of April, Mr. C. D. Wise wrote me from the Toddington Fruit Grounds, Winchcombe, Glos.:—"I am having the *Phytoptus* picked off our Black Currants, and I am sorry to say the women pick *baskets full.*" This trouble is well worth while, because thus not only the "Gall-Mites" themselves are got rid of, but also vast numbers of eggs, which would soon have sent out new supplies of infestation. Amongst specimens sent me on the 4th of April from Hanbury, near Droitwich, I found the minute white eggs in various stages of development; some still round or roundish, and others pushed out of shape at one end by the pressure on the thin egg pellicle of the bluntly-pointed head of the Mite within, the locality of the legs of the Mite being also indicated by little knobs, showing the position within of what might be called the shoulders.

So long as the buds are infested by scores or hundreds of Mites, and their eggs remain on the bushes, it does not appear likely that much good would be done by applications of either fluid or dry dressings, for the Mites would, for the most part, be protected within the sheltering gall leaves. But when all the propagating colonies were removed and destroyed, it might be hoped that soft-soap and sulphur wash (or any other kind preferred) would do great good by destroying all Mites that were travelling on leaves or stems of the bushes.

Each grower should follow his own experience as to wash that may be useful, but I should incline myself to trial of the soap and sulphur wash introduced in the past season by the "Chiswick Soap Co.," Chiswick. This is made somewhat, though not exactly, on the lines of the mixture known in South Australia as "Burford's Compound," which was especially recommended by the late Mr. Frazer Crawford (Government Inspector in South Australia under the Vine and Fruit Protection Act, and a most excellent authority) for use against *Phytoptus* attack. Various forms of application of sulphur wash have been advised, as of sulphur and lime, also of sulphuret of lime with soft-soap; * but one advantage of the soft-soap and sulphur compound of the Chiswick Co. is, that after it has been mixed with water, and allowed to stand from sixteen to twenty-four hours, the sulphur dissolves, and thus a serviceable wash is attainable without any special arrangement for solution of the sulphur. The requisite strength should of course be tested before use on a large scale on different ages of leafage, but when properly managed I have found, in my own garden, that even the delicate early spring leaves of Peaches and Apricots were quite uninjured by spraying with the compound.

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* See my '9th Report on Injurious Insects,' p. 35.

When the attack has once settled on large Currant grounds, it is most difficult to get rid of it; but a watchful eye, and prompt measures of extirpation on the first sign of its appearance, will do much to keep it out; and the following note, with which I was favoured by Mr. J. Wright, Assistant Editor of 'Journal of Horticulture,' gives some very useful suggestions:—"About twenty-three years ago this Mite suddenly took possession of a Black Currant bush in a garden, then in my charge, in Lincolnshire. The next season *all* the buds were knobbed. The following season it ruined one side of the next bush. I did not know what it was, but saw it was ruinous, therefore chopped the two bushes level with the ground, burned them, and threw a shovelful or two of lime on the stumps and soil. Fresh growths pushed and grew into bearing, and quite free from the Mite."

Parasites.—During the past season specimens of two kinds of parasitic insects, found in the *Phytoptus* galls, were sent to me by Mr. W. Gibbon, of Seaford Grange, near Pershore, Chairman of the Evesham Fruit Growers' Experimental Committee; and their presence suggests the hope that with the increase of *Phytoptus* disease, the increase of Mite-feeding parasites may be following in its train.

On the 20th of April, Mr. Gibbon wrote me that he remarked that in the Black Currant gall, or knob, a white milky-coloured worm or grub, one-eighth of an inch in length, would be found with *Phytopti* all about and around it. This grub, Mr. Gibbon noted, he could not find had been observed by others, and he sent me a specimen (with the *Phytopti* still all about it) carefully secured between two pieces of glass.

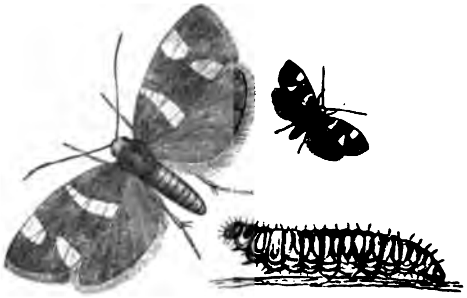
On examination I found that this was certainly the maggot of some kind of two-winged fly (a *dipterous larva*), and the accompanying circumstances seemed to show clearly that it was not merely a co-tenant feeding together with the *Phytopti* on the vegetable matter of the bud-gall, but was a carnivorous larva feeding on the *Phytopti* themselves.

Mr. Gibbon had placed the maggot and *Phytopti* between two glass slides, so carefully fastened together that I had some difficulty in cutting them apart; there was therefore no reason to suppose that the *Phytopti* could have escaped; but on examining for what might be present (before separating the glasses), and both with a two-inch and one-inch power, no *Phytopti* at all were to be found. After separating the slides, and again examining with a one-inch object-glass, I still found no *Phytopti*, but I was very much struck by the condition of the fly maggot. Instead of being shrunk and empty, as might have been expected, from starvation during the time of its postal transmission, things were quite otherwise. It was observably swelled out with food, and this not mere juice, but of such a solid nature that I was able to remove it on to the glass slide. From this it appeared hardly possible but that the fly maggot must have consumed its fellow passengers on the journey; and if so, the fact of there being a carnivorous grub co-operating with us in keeping down the Mite pests, is one which it would be well to trace onwards to the development and identification of the perfect insect, and then to consideration as to how its presence might be multiplied. This I suggested at the time to Mr. Gibbon, who took much pains in the matter, and though not successful in developing this special parasite, or apparent Gall-Mite feeder, his observations were perhaps still more valuable by showing the very numerous presence of another parasitic insect enemy.

On June 17th, Mr. Gibbon forwarded to me, by careful hands, a glass (still unopened) in which, secured beneath the cover with the galls from which they had developed, were what proved on examination to be a large number of minute four-winged flies. This being at a time when I was unfortunately too ill, from a severe attack of the influenza then prevalent, to attempt to identify them, I forwarded them to the better-skilled hands of Mr. O. E. Janson, who told me they were Chalcids, but as yet we have not obtained identification as to the species. The *Chalcididæ* are a family of Hymenopterous flies, usually parasitic, and usually of brilliant colour, with four almost veinless wings.

In the case of *Phytoptus* attack, there do not appear to be either the difficulties or the objections in the way of rearing the parasites which occur where the host is an insect and is very similar in size and appearance with its tenant. As the *Phytopti* cannot fly, there is no danger of them being dispersed together with their winged parasites. No greater care would be required for rearing than (when the infested galled buds were picked from the shoots) to throw these galls where they would be in fairly natural circumstances. They should be only thinly sprinkled over the surface where they are thrown, in order that they may not mould, and also that the Chalcids as they emerge may be able to fly freely away. They should not be exposed to a drying sun, nor to be soddened by rain, nor to be at the mercy of the small insect-feeding birds. Nor yet should they be where the Mites can get back to the bushes. Probably a space on the floor of an open shed would answer well.

"Currant-shoot" Moth. *Incurvaria capitella*, Fab.



INCURVARIA CAPITELLA.*

Moths, magnified and nat. size, from life. Caterpillar, magnified, after Stainton.

The *Incurvaria capitella* is a small moth which, so far as I am aware, has no special English name; but as the caterpillars are injurious by feeding within young Currant shoots, perhaps the name of the "Currant-shoot" Moth would distinguish it fairly well.

The moths figured above were sketched from a specimen of the *I. capitella* kindly given me by Mr. T. Doeg, of Evesham, who bred the insect from larvæ taken in shoots of Red Currant, on the fruit plantations belonging to the Toddington Fruit Company, in Gloucestershire. The little moths are about five-eighths of an inch across in spread of the fore wings; head with a thick tuft of ochrey hair above. Fore wings dark brownish or fuscous, sometimes with a purplish satiny gloss, a pale yellow band across the wing at about one-third of its length from the root, and two patches, also pale yellow, about half-way between the yellow band and the tip of the wing: these two patches are respectively on the fore and hinder edges of the wing, and the hinder patch is somewhat triangular in shape. The hinder wings pale grey.

The note of habits of this moth given in Stainton's 'Tineina' is:—"Common among Currant bushes at the end of May. The larva is very injurious, eating the pith of the young shoots, and betrays its presence by the withering of the young leaves when quite young; it is dark red, but when full fed it is greenish white."

In the 'Pflanzenfeinde' of Kaltenbach, p. 260, a little is added to this information:—"The larvæ (according to Stainton and A. Hartmann, of Munich) live early in May in the young shoots and buds of the *Ribes rubrum.* These they devour even to the pith of the twig. The moths fly about the Gooseberry bushes" (Stachelbeer-straucher) "in the morning hours."

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* The neurations of the wings only show partially so long as the plumage remains. To display this characteristically the scales must be removed. This is well shown by various comparative figures of wings, denuded and undenuded of scales, given in Stainton's 'Tineina,' plate 2.

The caterpillars of the *I. capitella* are an exception to the other kinds of *Incurvaria* in respect that they feed in Currant twigs; whilst of the other species, "The larvæ live in cases formed of pieces of dead leaves, and feed on the fallen leaves during the autumn and winter." * Still it may be open to doubt whether this point does not need enquiry; for in Kaltenbach's remarks, before quoted, he mentions the winter-cased caterpillars of the *I. capitella* being found about Beech trees. If this is so, they might prove on examination to be also about the Currants, and we might thus have a means of clearing some of the infestation. And it will be seen in the following observations, with which I was favoured by Mr. C. D. Wise, of observations of the attack in the Fruit Grounds at Toddington, Gloucestershire, that he also thinks it possible that chrysalids may be found in the earth beneath the bushes.

Mr. Wise wrote me that "about the 20th April we noticed numbers of the young shoots of the Red Currant bushes had withered up and drooped. On examination we found in each a small grub which had bored its way up the stem." Specimens of the moth reared from these caterpillars, from one of which the illustration at p. 44 was figured, proved the attack to be of the *Incurvaria capitella.* Of this Mr. Wise further remarked:—" The moth hatches the end of May and early in June, and from our observation we are pretty sure that the caterpillar turns into chrysalis in the earth beneath the bushes. The remedy we adopted for this pest was to pick off the infested shoots and burn them, which of course means a lot of labour; but what else were we to do?"

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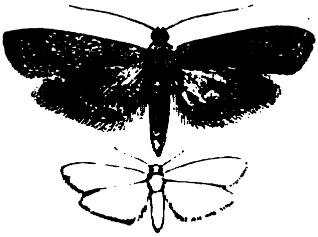
* Stainton's 'Tineina,' p. 40.

FLOUR MILLS AND STORES.

Mediterranean Flour Moth. *Ephestia kühniella*, Zeller.



EPHESTIA KÜHNIELLA.
Mediterranean Flour Moth, magnified; outline showing natural size.

The attack of the Flour Moth continues steadily to spread, and as, besides other localities, I am aware of it being present in Yorkshire, Cheshire, and Carnarvonshire, it may be considered to be fairly established in the country.

So far as appears at present, this spread will go on until the losses from the fairly overwhelming nature of the infestation, where it is once permitted to establish itself in Wheat mills and stores, so absolutely *force* it on attention, that the nature of the attack will be known at a glance, and protective as well as remedial measures be brought to bear.

At present, so far as I may judge from applications to myself, millers suffering under this injurious attack naturally keep the matter as quiet as they possibly can; and enquiries which I receive on the subject being in business confidence, I am unable to give the requisite cautions in the neighbourhood of infested premises. But though it is a matter of great difficulty and expense to clear a mill where the pest has once made good its entrance, still much might be done by other millers, store and warehouse owners, bakers, householders (in fact by all purchasers or holders of Wheat flour), being on the alert as to the condition of the consignments sent them, and also of their own returned sacks. In one instance reported to me, where this moth (duly identified) "swarmed," the millers stated that it first came in some returned empties (sacks). They noticed these grubs at the time, but "did not consider them of any importance." All Wheat-flour millers should have such information accessible as will enable them to recognise this pest when they see it.

The moth is of the shape figured above, and of the size of the figure in outline; the colour of the fore wings rather pale grey, with darker markings; the hinder wings whitish and semi-transparent.

The grubs or caterpillars, when full grown, are somewhat over half an inch long, and, as seen without the help of a magnifier, almost white, when younger of some tint of flesh colour or pale red, and are slightly sprinkled with pale hairs or fine bristles. Feet sixteen in number, that is, three pairs of claw-feet (one pair on each of the three segments next the head), four pairs of sucker-feet under the body, and another pair beneath the tail. The markings by which this kind of caterpillar may be distinguished, with the help of a hand-magnifying glass, from other kinds are as follows :—Head yellowish brown, darker in front, and with dark brown jaws ; a transverse patch on the segment next the head, this rather pale yellowish brown, with a faint pale central line dividing it from back to front, and (in the oldest specimen) a small brown spot on each side of the segment below the patch. Along the back, excepting towards the head and tail, were four small dark dots on each segment, above, two on each side the centre. On the segments near the head the spots were arranged more transversely, and at the tail, immediately above the sucker-feet, was a brownish oval or somewhat triangular patch (the anal plate). On the preceding segment the transverse row of spots varied somewhat in different specimens ; the largest was in the middle, with a smaller one on each side, occasionally one below, which would make five altogether ; but sometimes the lowest pair was absent, sometimes the middle large spot was not entire ; conjecturally the marking differed with the age of the caterpillar. On the preceding, that is, the eleventh segment, there were two clearly defined brownish spots, and along each side of the caterpillar was a row of dark dots, one on each segment. When full grown the caterpillar changes to the chrysalis state (in the instances I have seen) amongst the spun-up flour, but I am not sure whether it is always in a silken cocoon. This chrysalis showed the shape of the future moth very plainly, and was peculiar both in shape and in colouring. It was the colour of bees-wax below, shading to reddish brown on the back, and reddish brown also at the end of the somewhat prolonged slightly curved tail, which ended bluntly or cylindrically ; the eyes were of a darker shade of red.

In the Canadian observations it is noted that " When not hidden in a package or deposit of flour, the larva has a habit of retiring to some crevice before passing the chrysalis stage ; consequently they are to be found in innumerable places quite impossible to be reached by any brushing-down process."

I have not myself ascertained how long the chrysalis state lasts. Prof. Zeller notes that the moth comes out in about three weeks.

From the various dates at which moths and caterpillars have been observable, this pest appears an all-the-year-round infliction.

The mischief is caused by the caterpillars dispersing themselves over every part of a mill, or its machinery, where the Wheat flour can be found,—whether in spouts and machinery, where they do no end of mischief, both by destroying the silks, and stopping the flow of flour in the spouts by spinning thin webs and hanging thereby,—" or by getting into all crevices and every cranny where there is flour to feed on." One characteristic point of the damage is the manner in which the caterpillars spin the flour (amongst which they feed) together with fine webs, so that it may be picked up in lumps or clots. The speed and thoroughness with which caterpillar possession is or may be taken, is shown in the various extracts from the 'Canadian Report,' before referred to, which are given in the following pages.

It is not, however, only in open parts of mills or their machinery that the pest is located. One of the very first observations of it in this country was in connection with flour in sacks. In 1887, Mr. Sidney Klein noted an attack in some large London warehouses where there were over a thousand tons of flour stored, and one entire warehouse was literally smothered with larvæ, and several hundred pounds worth of damage done.*

In a letter to myself, Mr. Klein noted they were not in the grain, but only in the flour, and especially in any light fluffy or branny stuff, and especially remarked, " My impression is that they have come to me from some baker in returned empty sacks." Further, in his paper before quoted (read to the Entomological Society), he mentioned that the eggs, which seemed to be laid by the moths "generally upon the top of the sack, hatched in a few days of being laid; and the larvæ, (caterpillars) at once burrowing through the sacking, commenced spinning long galleries in the flour, seldom, however, going more than three inches from the exterior."—S. T. K.

When the attack was first brought under my notice in 1888, I suggested turning on steam. This was done, the mills were stopped for a week, the machines were cleaned, and steam was applied by carrying about forty yards of half-inch piping into the mill from the boilers, and attaching an india-rubber bore to it, for the men to work about on the walls, floors, spouts, and machines, blowing the steam into all crevices and holes. This was followed up by washing the inside of the machines with strong boiling solution of soda and water. It was found that strong soda and water destroyed the maggot where it could be applied to them. Walls were whitewashed, and paraffin applied wherever it could be done without affecting the flour, even to syringing likely places for the moths to settle in, and for the time much good was done, but even with all the above expense and labour the attack was not cleared, and recurred to give further trouble.

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* See paper by Mr. Klein, read before the Entomological Society of London on Nov. 2nd, 1887.

On the outburst of the attack in 1889, in Canada, the matter was taken up by the Department of Agriculture of Ontario, and the measures adopted by the Steam Milling Co., on whose premises the attack had first been observed, being deemed insufficient, the steam treatment was improved on, under Government orders, by construction of a strong room or box, so arranged that steam under pressure could be drawn or driven into it. This box was six feet wide, six feet high, and twelve feet long, and a steam-pipe was attached to it from the boiler; and in this box every machine, and even the mill-stones and iron rollers, were submitted to purification from the infestation, by steam.

The result was, as stated in the Appendix (published at Toronto, on Oct. 15th, 1890) to the preceding 'Bulletin' on the Flour Moth,* "The measures which were taken by the Provincial Board and the Milling Co., on whose premises the moth appeared last year, have, I am glad to say, resulted in a complete eradication of the pest from such premises."—P. H. B.

This Appendix, which is addressed to "millers and produce-men," in view of important interests involved, and the loss likely to accrue to the export trade of the province (if the pest became prevalent), drew attention forcibly to the penalties there attached by law to any violation of the statute regarding selling unsound grain or flour. Further, they gave notice of the course they purposed to adopt in case the owners of infested premises had "so little regard for the public interests as to send sacks infested with the ova or larvæ of the pest to other places."

In regard to legal points: that in no way enters into our present consideration here, save to show the great importance attached to stamping the pest out immediately; but the measures to be taken for this purpose, which are given in the same 'Bulletin,' are well considered on good authority, and those which I reproduce below are applicable here as in Canada:—

"1. Destroy the moths. This can be done by closing the windows, doors, or other apertures of the building, and, night after night, until all evidences of the moths have disappeared, burn sulphur by placing it in shallow pans upon a number of heated stoves, say small coal-oil stoves, in different parts of the building, and putting a match to it.

"2. Search for evidence of larva or caterpillar in all packages, bags, &c., of flour or meal, and, wherever found, at once superheat the flour in a dry kiln. Spread it out in a thin layer, so that the heat can reach it and the packages, boxes, &c., containing it.

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* Appendix to 'Bulletin' 1 on the Flour Moth, issued by the Ontario Dept. of Agriculture, prepared by P. H. Bryce, Sec.

"3. Under no circumstances sell this material to other dealers, whether to mills or produce-stores, but have it treated with boiling water or steamed, and fed to pigs.

"4. Where webs have appeared, either in the packages of meal and flour, in the bolting-cloths and carriers, or in deposits of dust on ledges, along the walls, &c., it may be deemed certain that the larva has taken on the chrysalis stage. Hence it becomes necessary to make a close search in all these places for the cocoons, or little masses of flour glued together, of say three-quarters of an inch in length. These swept down can readily be gathered up and burned.

"It has, however, been already pointed out that, owing to the habit which the larva has of retiring to some crevice, when not hidden in a package or deposit of flour, before passing into the chrysalis stage, we find them in innumerable places quite impossible to be reached by any brushing-down process. Two ways only are left for overcoming this difficulty. The one that first suggests itself is that of waiting till the chrysalis is burst and the moth appears, and then kill the moth.

"This doubtless may be followed by good results, *i. e.*, have the first moths appearing destroyed by hand, and by subjecting the affected portions of a mill or building to repeated treatment with the fumes of burning sulphur every night when the works stop. If this is persistantly followed out, but little development of new forms will take place. It must be remembered that this work must be persistent and thorough; abundance of sulphur, burnt again and again, being the sufficient condition of success.

"Where, however, the larvæ have, as it were, gained possession of bolting-cloths and carriers, treatment with steam under pressure driven throughout all parts of the bolting-cloths, carriers, and other machinery, has been found very useful in lessening the inconvenience from the spinning of webs, and thereby the clogging of the machinery. The walls, floors, and ceilings may further be treated with advantage by first brushing down all dust, and thereafter spraying them with a solution consisting of a drachm of corrosive sublimate to each gallon of water, by means of a gardener's force-pump. Treatment by fumes from burning sulphur while parts are yet moist from this washing-down, will greatly aid the destruction of any larvæ or cocoon forms which may be reached."—See 'Bulletin,' pp. 12–14.

"*Note.*—To prepare sulphur fumes: place a metallic dish containing hot ashes on some support in a pan of water, or place in an old pan or other vessel a bed of ashes, at least six inches deep and about fifteen inches in diameter, and place the sulphur and saltpetre in a slight depression in the centre and ignite. The proper proportions are three pounds of sulphur and three ounces of saltpetre per thousand cubic feet of air space. All doors, windows, and other openings should be tightly closed before the sulphur and saltpetre are ignited."—'Bulletin,' p. 12.

Precaution necessary in fumigation.—In application of sulphur fumes, it is very necessary to attend carefully to amount that may be safely used, or great loss may ensue consequently on alteration in the nature of the flour through effect of fumes making it unfit for use.

In an instance brought under my notice, very heavy fumigating was carried out during three days when holidays, following on Sunday, allowed work to be suspended. In these three days, five hundred pounds of sulphur were burnt on two fires. The result was, as reported to me, that, there being eighty or one hundred sacks of flour left standing in the mill, the sulphur "penetrated right into these, and acted on the gluten of the flour in such a manner as to apparently break it up into soluble albuminoids, and render the dough made from it more like a lot of weak putty than the 'strong' dough our customers require."

Regarding this injured material, the chemist, in whose hands a portion was placed for investigation, wrote me as follows:—"I am engaged in examining samples of the damaged flour, which seems irremediable. But the right treatment would certainly seem to be exclusion from mill during fumigation of all flour and Corn, and repetition of the fumigation at least once a week until a cure is effected, the sulphur being used in indicated quantities. Only a manufacturer can appreciate the trouble and expense of such interruption to regular systematic mill-working, but there can be no question of the absolute necessity of taking prompt steps, whatever the trouble may be."—(W. S. C.)

If it were possible to alternate the grinding of other flour material with that of Wheat in infested mills, remedial measures could at once be carried out; but where neither the arrangements nor the delicate machinery of modern Wheat-milling allow of this, we are thrown on necessities of *skilled care* in preventing admission of attack, and the very troublesome remedial measures if it does get in.

The following notes, sent me on the 23rd of Oct. by a miller, from a district which I had not previously heard of as infested, show just the same characteristics of attack. Specimens had a short time before been sent, which the miller noted as "of a certain moth which has caused a great amount of inconvenience to the flour mills of this country during this year." He further mentioned that the chief source of inconvenience was due to the silky tissue, "which links, or rather gathers, together flour and other stock, forming a sponge which sometimes assumes such proportions that spouts are actually blocked up. They are also a trouble at the feed rollers, as they make the feed to roller mills and other machines uneven, and might at such a point do vast injury to the plant."

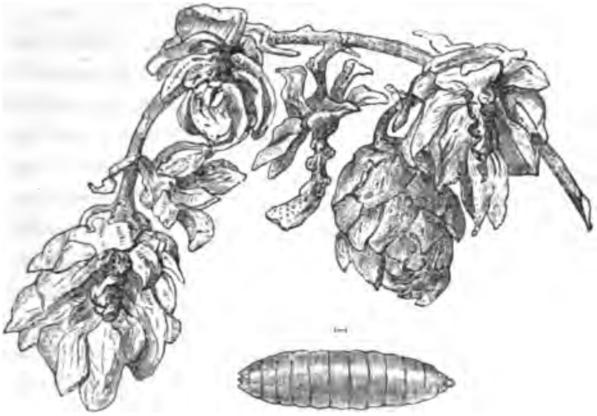
Unless the appearance of the pest in its different stages, and also the peculiar felted-up state of infested flour, *are known*, the attack cannot be properly fought; and in the foregoing paper I have endeavoured to condense what appear to be the most important points bearing on the subject, which have been brought forward since the first appearance of this mill trouble (in this country) in 1887. Details of the method of attack, and the means found of more or less service in prevention, will be found in the 'Bulletin' on the "Flour Moth," bearing date Oct. 19th, 1889, and the Appendix to the same of Oct. 15th, 1890, issued by the Department of Agriculture, Ontario, Canada; and in my own 12th, 18th, and 14th Annual Reports on Injurious Insects, in the first of which are references to some more purely entomological observations.

It is well known to all suffering under the pest how much some more information is needed as to remedial measures, and the above notes are only given as leading points in how far we have advanced at present, and also in the hope that those who know more may come forward and help by additional information, which would be a great public benefit.

I should be happy to receive anything sent to myself for publication, and meanwhile have had a separate impression of fifty copies of the foregoing paper printed for gratuitous distribution to any applicants practically interested in the subject.

HOP.

Strig Maggot. *Cecidomyia*, ? sp.



Hop catkins, showing effect of infestation; Strig Maggot, mag.; nat. length given at page 55.

The attack known as that of the Strig Maggot has long been known of as causing much damage to the Hop-cone or catkin, but it was only (so far as I can find) in the past season that we have been able to trace this attack with certainty to being caused by the larva of a *Cecidomyia*, or Gnat Midge, the maggots being therefore very nearly allied to the well-known "Red Maggot," which often causes much damage to Wheat.

In 1882, notes were sent me by Mr. Goodwin from near Sevenoaks, in which he mentioned that the attack had been very general in that neighbourhood, and had ruined several pieces of Hops. He observed that the "maggot pierces into, or rather is bred in, the 'strig' or stalk of the cone or flower, where it eats its way up the inside of the stalk, which causes the Hops to wither and turn brown." One or two maggots were the average number present, and in the early part of September these were very numerous; but later on, by Sept. 27th, they had disappeared, and it was observed, "they drop out into the earth after eating the Hops." Mr. R. Cooke, of Detling, near Maidstone, also forwarded Hops similarly injured, observing that the altered colour was from the attack of a maggot which burrowed in the central stem, and that the infested Hops began to go off from the tips, the stem which supported them dying back to the main branch.

With all the specimens sent, however, I did not succeed in finding a single maggot present; therefore had no clue to the cause of the mischief. In the following year (1888) specimens again sent me by Mr. Goodwin on the 31st of August (a date earlier than that named in his observations of the previous year) showed the mischief to be caused by the maggots of some kind of small two-winged (*dipterous*) fly. The "strigs" were tunnelled by the maggots, and on laying the Hops on a table the little maggots came out of them, and joining head and tail, like Cheese Maggots, skipped in all directions. Still, there being apparently no recorded description of this kind of attack to Hop, and also as I had not then the strong microscopic powers which I since procured, I did not manage to identify the larva; and no further specimens were sent me until the past season, when I was able to determine the larva with certainty as being that of a *Cecidomyia*.

The first samples sent me were forwarded on September 22nd, from The Parsonage, Cobham, near Gravesend, by Miss E. J. Stevens, with the remarks:—"I am writing to ask whether you can tell us of any remedy for an attack of Strig Maggot in Hops, or anything which could be used to prevent it another year." . . . . "My father has had the Hop-ground for the last fifty years, and it is only the last two or three seasons the maggot has been troublesome. This year it is worse than it has ever been. We burnt most of the bines last year, instead of wisping them, thinking that might make a difference, but the maggot seems to leave the Hops before the healthy ones are ripe. The Hop-ground is well cultivated; farm-yard manure is used. There has been very little mould this summer, and sulphuring has only been done twice, about 40 lbs. per acre of flour of sulphur each time."

The bunches of Hops sent were undersized; some of them were pale green, some partially discoloured, and some wholly brown.

On investigation I found that in many cases the central stem of the bunch was destroyed, or partially destroyed, and apparently tunnelled by some enemy which for the most part, judging by the small perforations in the outside of the destroyed "strig," had finished its work by making an exit-hole and escaping.

On careful examination I found several kinds of small insects present, but of these the only specimens which could with any certainty be supposed to give rise to the injury were various larvæ of some species of *Cecidomyia*. These were of various tints, from white to a creamy colour, and of the usual form of this kind of maggot—that is to say, long, cylindrical, and pointed at the head end, and furnished near this extremity beneath the body with the peculiar process known as the "anchor process," or "breast-bone."* This was bifid at the free extremity, the points of the fork blunt, and the portion immediately below this with a slight inclination to a bulb shape, the stem rather slight and narrow. Most of the maggots were free, so that it could not be told whether they were feeding on the part where found; but in one instance, where the portion of the short attachment of a separate flower to the central stem of the bunch (or strig) was only partially injured, I found one of the Cecid maggots lying within, with a narrow stripe of bright green colour running partly along the central line, and showing through the white transparent skin.

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* For figure of a *Cecidomyia* maggot, see also paper on Tare Cecids.

This clear evidence that the Cecid maggot absolutely feeds on the juices of the strig, joined to the observation of the great numbers present, appears to show beyond doubt that we have here the obvious cause of the Strig attack.

Samples of infested strigs were also sent me from Knight's Place, Rochester, on the 24th of September, by Miss C. E. Pye, who remarked:—"I am sending you, by my father's request, a few Hops which have been damaged by the insect which eats the stem of the Hop. It has done us a great deal of damage." And information was asked as to the nature of the pest. On examination I found minute white maggots. On breaking one central stem I found two within, in another I found one, and others dropped from the diseased cones.

The damage consisted in the central stem of the cone being so destroyed by the attack that the outer rind and the central longitudinal fibres were much separated, and this attacked portion decayed, as did also the short side stalks of the separate flowers. Thus the "strig" became a mere dead and decayed mass, showing tunnels and cell-like cavities caused by the injury from the feeding of the maggots, or by the thin rind over the injury splitting away from the central fibres.

The maggots had certainly power of skipping, for I noticed one or two in the act of thus changing position, and constantly during progress of examination I found the maggots had left the spots where they were noticeable a short time previously. They varied a good deal in size; the average length was about one-sixteenth of an inch, but they ran a good deal both smaller and larger. The "anchor process" beneath the head end of the body of the larva was plainly noticeable. This was deeply and somewhat bluntly bifid at the free extremity, and had a rather long and slight stem. The Hop-cones were stunted and small, and broke up easily, from the destroyed condition of the central stem.

Specimens of the same infestation were also sent me by favour of Mr. Matthew Bell, of Bourne Park, Canterbury, from the Hop-grounds at Chelham Castle, also near Canterbury; and in these, as well as in those above noticed, the deeply bifid anchor process was clearly observable. Mr. Bell mentioned that he forwarded these as a sample of Hops which were infested by a minute grub which eats the core of the Hop so that the leaves of the cone all fall off, together with some notes regarding them sent by Mr. W. Butt from the Estate Office at Chelham Castle. At this date (the end of September), judging from reports or samples sent me, the maggots were leaving the Hops; and Mr. Butt noted that some of the maggots would be found concealed in the stem of the Hop, but that they were somewhat difficult to find. In most of the Hops which he picked he could not discover one, although it was easily seen that one had been in the Hop. He noted that in two Hops he had found a couple of maggots in each, and in another (forwarded) there were three, and that the maggots showed very distinctly if they were turned out on white paper, they being of a bright reddish orange colour, and likewise observed that he could not feel certain as to whether "they could crawl from one Hop to another or not." This is a rather important point, which could be ascertained by observation earlier in the year, before the maggots were leaving the Hop-cones for their winter-quarters.

On the 80th of September, Mr. Edw. Goodwin, writing from Canon Court, Wateringbury, Kent, forwarded me specimens of Hops which, from the state of the centre of the cone, had evidently suffered from attack of the Strig Maggot. Mr. Goodwin remarked, regarding this attack of the "so-called Strig Maggot":—"It seems only to appear in very wet seasons; last year it did a good deal of harm, but this year the mischief caused by it is quite incalculable. I believe that a very small insect lays its egg in the Hop during the early part of August; in a short time a pinky white larva appears, which lives by eating the strig (*i. e.*, stem or midrib), and the Hop withers from the point where it has been attacked."

Prevention and Remedies. —As (so far as I am aware) there are no published records, either of the nature or the name of this infestation or of measures to keep it in check, we can at present only rest for guidance on such knowledge as is before us of the habits of the insect. But, so far as we see at present, this maggot (like those of various other kinds of *Cecidomyiæ*), when it is full fed, leaves its feeding place and drops down to the ground, for its winter shelter, there to undergo its changes, and from thence to come up again in the following summer, in perfect state, to lay its eggs in the Hop-cones.

We have clearly made out both that the maggots fall to the ground and that they then bury themselves in the earth, from the following very good observations reported to me on the 26th of September (in reply to some remarks of my own) by Miss E. J. Stevens from Cobham, near Gravesend:—"You are quite right in supposing that the maggots fall from the Hops to the ground. The afternoon I received your letter I spread some black lining under two of the Hop-hills, and the next morning there were hundreds of maggots on it, jumping about. We brought some home and put them on some earth in a box, and in two hours they had nearly all buried themselves in the earth." . . . "The same parts of our Hop-grounds seem to be most infested with the maggots each year, so it does not seem as if the midges travel far before they lay their eggs."—(E. J. S.)

What is needed is, to destroy the maggots between the time of their going down and that of their development to gnat midges and flight. It may certainly be considered that they lie either at the surface, in rubbish that may shelter them, or very little below it, because the maggots are too little to pierce down deeply with any chance of the minute and weak gnat-fly of soft texture, and with no apparatus for boring, coming up to the surface through a weight of earth. But how to get rid of them is a question for Hop-growers. Most likely dressings of farm manure would do little, if any, good. Caustic dressings thrown on the surface of the soil, or lightly forked into it, not of kinds or in quantity to injure the roots, would very likely be beneficial. Stirring open the soil, or clearing off the surface, as well as could be managed, and throwing it thinly about so as to expose the maggots to winter weather and birds, would probably do some good. Or if a dressing *could* be used, of ashes or dry earth with a little paraffin in it, this, if thrown on the hills at the time when the Gnat-midge might be expected to come up, might very likely indeed do good.

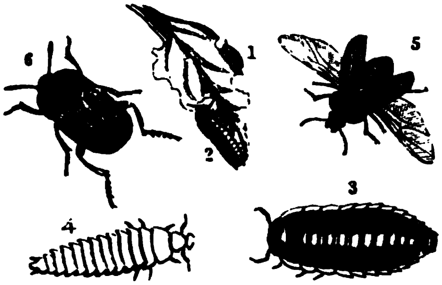
In the Stoke Edith experiments regarding Hop Aphis, we found the above application, in the proportion of a quart of paraffin to one bushel of dry material, did not in the slightest degree injure the Hop-shoots which came up through it, and there was no appearance of Aphis attack on the bines from these hills (though it occurred on those of which the soil had not been thus dressed), until attack came in winged form.

From this we considered the wingless Aphides could not come up through the dressing, and I should not think that the little Cecid gnats would be more capable of penetrating. The time when the mischief is begun must be after the Hop-cone has made much of its growth, because (so far as specimens sent show) the cone is not so much injured by being stunted in growth as by the central stem being tunnelled. We find the grown or moderately grown strig with the tunnels in it.

But, excepting the date when the Gnat-midge appears, there seems to be all information at hand regarding its life-history that is requisite for applying remedial measures, if those most conversant with treatment of the Hop-hills could work out how these should be arranged.

MANGOLDS.

Beet Carrion Beetle. *Silpha opaca*, Linn.



SILPHA OPACA.

1, 2, young grubs feeding; 3, 4, grubs differing in shape, somewhat magnified; 5, female beetle flying; 6, male beetle, magnified.

The attack of the Beet Carrion Beetle to Mangolds has so rarely been noticed in England, that I believe this is only the second year in which it has been so recorded as having been observed here, although the beetle is very commonly to be found in connexion with small dead animals, whence the second part of its name. It has long been known as occasionally occurring on Mangolds in Ireland, and in 1888 it was found to be severely injuring Mangold plants at three distinct and widely separated localities in England, namely, near Shrewsbury; near Newport, Mon.; and at some farms near Honiton, Devon.

In the past season it was again recorded as present, and again in Devonshire, but only at one locality, namely, Batworthy, Chagford, near Newton Abbot, in the Exmoor district, a good many miles from the previous places of appearance near Honiton.

On the 1st of July, Mr. F. N. Budd, writing from Batworthy, with specimens of the grubs accompanying, noted that these were samples of larvæ which were doing great damage to his Mangold crop, and so far as he could make out were larvæ of the Beet Carrion Beetle (*Silpha opaca*); but, Mr. Budd observed, "I have never seen them before, and presume they are not commonly met with in this country as a Mangold pest."

The grubs were certainly the black, somewhat woodlice-like grubs of the Beet Carrion Beetle, which, though variable in shape, as shown in figures 4 and 5, may be known by the sharp edges of the sides of the segments (succeeding the three first), which altogether give a saw-like appearance to the sides of the grub; the sides of the three first segments are rounded.*

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* For descriptions and observations on attack of 1888, see my 12th 'Report on Injurious Insects,' pp. 91—96.

On the 7th of July, Mr. Budd further remarked:—"This particular pest has now pretty well left my Mangolds. A diligent search has resulted in one small larva found alive, and several empty shells, but no pupæ and no perfect insects. I cannot account for their sudden disappearance from my crop, unless it be that the insect has reached its perfect stage and gone away. I fancy I only observed the larvæ at a comparatively late period of their existence, when the majority of them were approaching the chrysalis stage, but yet the specimens I sent you were, as you observed, by no means full grown, and the larvæ were at the date of my letter plentiful."—F. N. B.

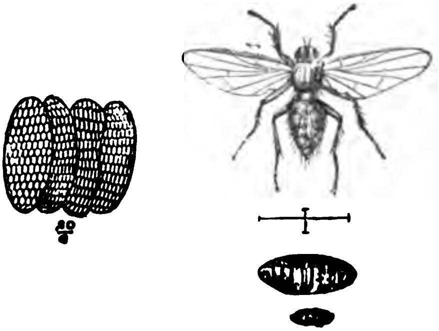
It seems to me that, if another opportunity should occur, it would be well worth while to watch what may happen at this stage of life among the grubs, that is to say, whether a portion of them may not feed on their brethren. In regular course of things the grubs have been recorded as going down into the ground when full fed, which may be about the end of June. There they form cells, about three or four inches beneath the surface, in which they change to the chrysalis or pupal state, and from these the brownish black, rather downy beetles may be expected to appear in about three weeks.

But in the course of my observations of the Beet Carrion maggots in 1888, I found, in the case of two consignments sent me, that some of the grubs had apparently been feeding on the others, as there were broken remains of the skin of other *Silpha* larvæ in the box. These broken pieces would correspond with Mr. Budd's description of "empty shells"; and looking at the fact of his grubs being by no means full grown, therefore unlikely to go down into the ground at the time, it certainly seems open to doubt whether they did not exercise their normal carnivorous propensities on each other. It would at least be worth while noticing, as occasion might allow, whether this is the case.

As the ordinary details of this attack and means of prevention and remedy have been given in my Report already quoted, also as it is very rarely of any practical importance in this country, I do not repeat them again here, but just mention the attack to keep up record of what so far as appears is, in this country, a rare crop infestation.

Mangold-leaf or Beet Fly. *Anthomyia* (*Chortophila*) *betæ*, Curtis.

Mangold-leaf maggot was unusually prevalent during the past season. This attack is usually reported to a moderate extent, or at least as being present at a few localities; but last year (1891), so far as I can judge by reports sent to myself, it was far more prevalent than in any year since the severe attack of 1880. In that year it was destructive in various localities, and especially in Westmoreland and Cumberland, "where of 1624 acres of Mangolds grown in those counties, it was reported that all were infested."



ANTHOMYIA BETÆ.

A. betæ (female), mag.; line showing spread of wings, nat. size; pupa, nat. size and magnified. Eggs (after Farsky), mag.

In the past season it was reported in the more southerly and westerly parts of England. The worst attack was in Devonshire, where the infestation was severe and widespread in the northern districts; it was also reported from near Camelford in the north of Cornwall, and from various localities, either single farms or districts, respectively in Warwickshire, Oxon, Notts, Northamptonshire; from Knebworth, Herts; Royston on the border of Cambridgeshire and Herts; Hawkhurst on the border of Kent and Sussex; and likewise in Hants, and also at Treffgarne, in Pembrokeshire, and from farms near Abergele, in Denbighshire. The first specimens were sent about the 22nd of June, and enquiry continued at intervals from that time up to the beginning of September, thus including observation of the whole summer's attack, from the first outbreak, more or less ruinous, on the young plants, to the commonly less hurtful blisterings in the autumn leafage.

No new points have been brought forward in the history of the attack itself, which is well known, but for practical purposes it cannot be too well known and clearly laid down that *the* great characteristic of this attack is the leafage being first marked with blisters where the maggots feeding within have separated the upper from the under side of the leaf; and afterwards, when the attack has gone on for a while, these portions turning, as they die, to a brown colour. Thus, where attack has been going on badly for a time, a great part of the leafage may very likely look brown and scorched.

Where the attack is not recognised, the injured leafage is very likely to be at first considered merely "scalded," and thus valuable time is lost in applying some remedy which would in all probability have pushed on the crop through the time of infestation.

The method of attack is for the fly to lay her white eggs (see figure) (which look very like common "fly-blows") on the under side of the leaves. The maggots from these bore into the leaves, and there feed for about a month. These maggots are little, legless, cylindrical grubs, somewhat tapering to the head end, and whitish in colour, or sometimes greenish from the coloured juice on which they live showing through the transparent skin. When full fed they turn to chestnut-brown puparia, of the size and shape figured at p. 60 (nat. size and magnified). This may be either in the leafage on which they have been feeding, or in the ground beneath them, and from these chrysalis cases the two-winged flies come out *in summer* in about a fortnight or less.

These flies may be generally described as of an ashy grey colour, with some darker markings and with black bristly hairs, and are said to appear as early as from March to May. These lay the eggs of the first attack, and broods may continue through summer and autumn, but two broods may be (under common circumstances) quite expected. The last brood of the year may pass the winter either in chrysalis state or sometimes as the perfect insect.

The following observations are given much in order of the date in which they were received. Amongst points of interest, one is the great number of eggs which may be found on one leaf, and also how soon the maggots hatch. Also the very valuable observations given in detail by Mr. Haydon as to any treatment, or condition of soil, or of situation, which is calculated to push on good growth, being beneficial in lessening effect of the infestation, or carrying the plant over attack (see p. 68). The observation also of Mr. Coutts (p. 64), "They came first just after being singled," is well worth notice, as drawing attention to the time when presence of attack and the need of remedial measures may especially need attention.

Amongst badly attacked specimens sent me, on June 22nd, by Mr. John Hilder (bailiff to Mr. P. Beresford Hope, of Bedgebury Park, Flimwell, near Hawkhurst), I found about one hundred and forty-six eggs of the Mangold Fly, possibly more, on the under side of one Mangold leaf, only a little more than three inches and a quarter in the length of the blade. Some of the leaves were already severely blistered. Mr. Hilder noted how very quickly the maggots hatched from the deposited eggs.

On the 24th of June, Mr. C. E. Bruce Foy, writing from Mollington, near Banbury, with badly attacked specimens accompanying, mentioned that his Mangold plants were infested this year with the grub in the leaves, of which he sent samples, and that several farmers in the neighbourhood, as well as in the Rugby district, had their Mangolds similarly affected.

This proved to be a decidedly bad attack of Mangold-leaf maggot; some were just turning to chrysalis state in the blistered leaves, or amongst them, as the case might be, and many were straying about amongst the leaves sent. Most of these were nearly or quite full grown.

With regard to treatment of the field, Mr. Bruce Foy observed:—"I mucked the field in the autumn, and drilled the Mangold seed on April 25th; they have been flat hoed and are now singled out; but I notice each day the leaves are becoming discoloured, and in some cases I have found as many as twelve grubs of various sizes and ages in one leaf, and you will find plenty of them in the sample I send. I have to-day sown soot between the rows of one acre, and on another acre a mixture of nitrate of soda and salt, in the hopes of pushing on the plants."

A few days later (on the 29th of June), Mr. Richard Ramsden, writing from Chadwick Manor, Knowle, Warwickshire, observed:—"I send you herewith enclosed a sample of a Mangold leaf with attacking insect or insects. I do not remember ever having seen such an attack before, and it has covered the whole field of two or three acres, *scarcely a plant escaping.*" In this instance I had not enough sample to enable me absolutely to make sure by examination of the nature of the attack, but it was not open to doubt that it was of Mangold-leaf Maggot.

In a further communication, Mr. Richard Ramsden added the following remark as to previous non-observation of the attack, which would probably explain also the previous non-observation of it in other localities where it was reported as now being first seen:—"Carefully thinking over the matter, I expect I have seen it before, but when the Mangold was in a more advanced stage of development, and possibly then I attributed it to the leaf being scalded by sun. This attack is very general; more plants are evidently struck by it than have escaped, and it is in two fields of mine."

About the same date as the above, namely, the 29th of June, Mr. John E. Thurnall, writing from Royston (on the border of Cambridgeshire and Herts), sent specimens of the Mangold Maggot, with the following clear description of the attack given in few words:—"It appears that some fly deposits its eggs on the back of the leaf, and that a maggot then appears between the tissues of the leaves, and causes the leaves to fail and ultimately destroys the plant." Mr. Thurnall further added that he had been that day (June 29th) over a Mangold field on a farm near Knebworth (Herts), and every plant seemed to be affected.

On the 30th of June the first notes were sent me of what was shortly after reported as a widespread and severe attack of this Mangold infestation in North Devon. Mr. R. W. Haydon, writing from Great Coombshead, North Molton, Devon, reported:—"I am sending you by this post some Mangold leaves attacked by the Mangold Fly. You will find the maggot of this fly beneath the epiderms of the leaves. I have taken the leaves from a field of Mangolds on my father's farm. A large number of farmers in North Devon are complaining that the fly has done considerable damage to the young Mangold plants. I have only inspected the fields of Mangolds on my father's farm, and although they are certainly damaged, still I think the crop will not suffer to any great extent."

On the following day specimens of infested Mangold leaves, with the maggot fully or nearly fully grown, were forwarded to me from Hele, S. Molton, Devon, by Mr. Christian Gould, with the note that they were samples of Mangold leaves from his crop of ten acres, which the maggots were destroying, and which would be quite a failure unless something could be done to exterminate them.

Other information was sent about the same date, referring to this same attack (well described as of the Mangold leaves containing maggots in blisters like those caused by the Celery fly) being severe in North Devon.

On the 1st of July also observations were made of the same attack occurring near Camelford, on the north of Cornwall. The attack about this time became so general in the district, that it was brought forward in various of the western papers (in some degree referring to my own remarks) by Mr. W. J. Harris, of Halwill Manor, Beaworthy, North Devon; and later on I was favoured by the following further notes from Mr. R. W. Haydon, of Great Coombshead, North Molton, Devon, in continuation of those previously sent on the 30th of June. These, it will be seen, are of serviceable interest, as they note a general opinion of the farmers as to nitrate of soda being beneficial in carrying the infested plants over attack; also they mention the benefit of previous good cultivation, and of various special dressings, and that crops in situations favourable to growth suffered less than others, and likewise some amount of estimate of loss is given.

Mr. Haydon wrote as follows:—"I have made numerous enquiries about the attack, and have visited many farms in various parts. The early-sown Mangolds have generally suffered more than the later ones. Mangolds sown on the flat have suffered *less* than those sown in ridges. All the farmers corroborate what you say in your pamphlet about the effect of nitrate of soda. The attack was pretty well universal, and, as might be expected, those crops which were existing under the most perfect conditions of growth best survived the attack. Where the land was well cultivated and made firm, and had received sufficient dressings of nitrogenous manures, in addition to salt and superphosphate, the crop best overcame the attack.

The *late*, *cold*, and somewhat *dry* spring checked the growth of the crop, especially those on ridges. I have noticed that those crops in favoured situations, as regards climate, have suffered least of all. In Devonshire, where the hedges are very high,—higher than those of any other county,—that portion of the field which was sheltered by these hedges grew away from the attack better than the rest of the field. Mangolds on high-lying light land have suffered most. I have seen a number of farmers who estimate that their crop will be reduced one-half by the attack. This means a loss of from £5 to £10 per acre. In a few cases the crop has been totally ruined.

On the 21st of July, also, I had information from Prof. Douglas Gilchrist (of the Bangor University College, N. Wales). Writing from Hafodunos, Abergele, Denbighshire, of the presence of the Mangold Maggot in that district, he mentioned that the attack had considerably delayed the crop, which was not one grown extensively in the district; and also that here, as in some other instances, the infestation was reported as not having been seen before in the district. This, however, is probably from the blisters on the leafage being ascribed to scalding or unfavourable weather influence of some kind or other, and consequently no special examination made which would have shown the maggots within.

Other communications regarding presence of attack were sent, which it is not worth while to enter on in detail; but towards the latter part of August information was continued, showing the presence of the late summer attack.

On August 20th, Mr. C. Coutts, writing from the New Inn Farm, Widmerpool, Nottingham, observed:—"We are the second time this season troubled with maggots in the Mangold leaves. They came first just after being singled, and then in ten days or so left. They have come again, but worse than the first time. The leaves are badly shrivelled up." . . . . "There are five fields badly damaged, and we have two fields that have not been touched as yet, but look healthy and doing well. I find the fields that are manured with artificial alone are the worst."

On the previous day (August 19th) specimens were sent me by Major F. Willan, from Thornhill Park, Bitterne, Hants, with the following notes, which show what great injury was then being caused by the infestation:—"Herewith I send some specimens of Mangold leaves. The crop, in a ten-acre field, has been much infested with some grub, which establishes itself between the inner and outer parts of the leaf and eats its way along. Several may be seen in the leaves sent."

. . . . "My own crop *has* been in a fearful state, but the late heavy rains have improved its condition a great deal. Some other farmers near here are still worse afflicted. This disease was first noticed about three weeks ago.

On the 27th Capt. G. H. Ringrove forwarded from the Estate Office, Whittlebury, Towcester, specimens of Mangold leaves infested by this same maggot, and which, he observed, "appeared to be destroying the crop. We had a splendid show of fifteen acres, but now all the leaves are fast disappearing, and apparently from the ravages of this pest."

The latest communication which I received as to the presence of the maggot was sent me on the 1st of September, from Scolton, Treffgarne (Pembrokeshire), by Capt. J. Higgon. Blistered leaves and Mangold-leaf maggot were sent accompanying. Capt. Higgon noted that the attack "first appeared under the leaves like a fly-blow, soon grew into the maggot stage, and then destroyed every leaf. They are now dying off, but the Mangolds have been completely checked in growth of course.

PREVENTION AND REMEDIES.—It will be seen from the foregoing observations, especially those of Mr. Haydon, that this year's notes quite confirm the reports previously given, of the importance of all treatment and measures of cultivation in preparing ground for Mangolds which are suited for pushing on strong and healthy growth, and thus, though not preventing attack, at least lessening the bad effects. Also, amongst different dressings which are serviceable to keep up the strength of the plant, by helping to replace the destroyed leafage as soon as possible when attack is present, nitrate of soda is again mentioned as one found serviceable. These points have been given in detail before; therefore it is not worth while to repeat them, more particularly as they are such matters of treatment as are thoroughly well known to all Mangold growers.

ORCHARD CATERPILLARS.

Winter Moth, Evesham Moth, *Cheimatobia brumata*, Linn.; and various other species.

CHEIMATOBIA BRUMATA.

Winter Moth. Winged male and wingless females.

The subject of orchard moth caterpillars and prevention of their ravages has now been entered on in these Reports so fully, and for so many successive years, that it appears unnecessary to offer further observations again this year on the points which have been already so thoroughly gone into. We have before us, from careful and skilled observation, not only the full life-histories of the most injurious kinds, but special points in their habits showing us (particularly in the case of the Winter Moth) how they can evade (that is, some proportion of them can evade) the barrier of grease-banding set before the wingless moths, and how their various ways of neutralising the use of these barriers, by laying eggs beneath them, or bridging them over for convenience of later comers, has been met. The more extended time of appearance in autumn, and the existence of winter and spring appearances, have been much more fully made out, and with the knowledge of the greater need for preventive and remedial measures we have also detailed record of the enormous advance that has been made in these.

Where the measures of former days, as, for instance, tarring the trees, has been proved to be inefficient and dangerous to the growths, we have improved on it step by step till we have now full details of how the grease-banding, which has taken its place, not only can be, but *is*, constantly carried out so as to be of great service. Also—and which is of the highest importance in the present considerations—we can lay our hands now on precise details of washes or sprayings of various kinds, which may be brought to *bear at once* on the ravaging hordes of caterpillars, if, either from their parents having evaded preventive measures, or having, in the case of various kinds, come in natural course on the wing, these their progeny suddenly appear in myriads on the growing leafage, This advance has been the work of years, and the result of observations of many orchard growers; but in especial it appears to me that we are indebted for much well-authenticated information to the work of the Experimental Committee of the Evesham Fruit Growers. Under their care experiments were carried on, according to definite rule, and the results examined and reported on at their successive meetings on the large grounds of the different members where they had been carried out, and measures recommended accordingly. Thus we have well-skilled and thoroughly practical opinions to go on, and the Report of their operations during 1890, published early in the present year, is well worth perusal.*

In my own 12th, 13th, and 14th Annual Reports the histories of orchard moths and means for their prevention are entered on at great length, with information from many observers, especially bearing, in the 13th Report, on details of sticky banding, and various kinds of washes; and, in the 14th, on the great advance made by adoption of use of Paris-green spraying, together with the requisite directions for its safe and successful application.†

Under these circumstances I have endeavoured, in the following paper, to take up (with some requisite exception to save trouble in reference) only points which have been little brought forward; and first amongst these are notes showing that the condition of the moths and their subsequent egg-laying did not appear to have been influenced by the winter cold.

The observations of orchard insects of the past season were commenced by the following notes sent me, on Jan. 30th, by Mr. Thomas E. Doeg, of Evesham, which are of much interest, both as showing the capability of the orchard moths for appearing so late in the season, and also that they were in no way injured or deterred from appearance on the first mild evening by the very severe cold term which had preceded the date of the observations.

It will be seen that the two kinds of moths noticed as being taken on trunks of Apples and Plums are the Winter Moth, *C. brumata*, and the Mottled Umber Moth, *H. defoliaria*. The moth named as being found in great numbers on the hedgerow, namely, *Hybernia rupicapraria*, is the kind popularly known as the "Early Moth," of which the eggs are said to be laid in February on Whitethorn, Blackthorn,

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* 'Report of the Evesham Fruit Pests Committee,' pp. 55, price 6d. Printed by W. and H. Smith, Bridge Street, Evesham.

† 'Reports of Injurious Insects,' by E. A. Ormerod, price 1s. 6d. each. Published by Messrs. Simpkin & Co., Stationers' Hall Court, London, E.C. I have also issued a short 8vo pamphlet of eight pages, with full directions for use of Paris-green, which I should be happy to forward gratuitously to any applicant desiring it for practical service.

&c.; so that this species was appearing about, or a little before, the customary time. The "Satellite" Moth, the *Scopelosoma satellitia*, of which it is mentioned that a few specimens were observed, hybernates in the moth condition, and is stated to come out in the spring, and lay its eggs in March; therefore, this kind also could not be considered to be suffering from the preceding cold. This moth is larger than the previously named species, and in shape, size, and general colouring, not at all unlike the well-known Turnip Moth, to which it is nearly allied. The chief difference is that the fore wings of the "Satellite" are reddish brown in the ground colour (instead of being pale grey-brown or dark umber-brown), and the hinder wings are smoky instead of whitish. This species is one which, if possible, should always be spared, because the caterpillars (at least, until nearly attaining their full size), are recorded as being carnivorous, and feeding on the caterpillars of other moths; amongst the kinds preyed on, young caterpillars of the Winter Moth are especially mentioned.

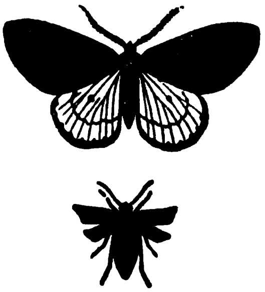
The "Satellite" caterpillar is described as being of a rich velvety brown colour, with three paler lines placed lengthwise on the second segment, and occasionally observable as faint stripes continued the whole length of the body. There are also about four white spots on each side of the body, but these may be variable in number.

I have not had the opportunity of studying the above-named insect myself in living state, and therefore acknowledge the above notes, as taken from the very good description given in Edward Newman's 'British Moths,' at pp. 371, 372.

With regard to the date of appearance of the moths, in reply to some observations or inquiries sent to Mr. Doeg by Mr. Gibbon, of Seaford Grange, Pershore, Chairman of the Evesham Fruit Growers' Experimental Committee, Mr. Doeg wrote, on Jan. 30th as follows:—

"I went to Seaford Grange last night. It was a mild dark evening, with a misty sort of drizzle; just the sort of night that yields a grand harvest of insects to the 'sugarer' when it occurs in July or August; and, as we anticipated, there were plenty of moths about. We took female *brumata* and *defoliaria* on the trunks of *Apples* and *Plums*, some of the latter trees being *amongst the Gooseberries*, where we noticed the 'borers' at work last spring. The Plum trees themselves were not much attacked last season, for Mr. Gibbon is an ardent believer in the *grease-band*. The males were not much on the wing, and my experience is that the Geometræ, as a group, fly *principally* just at *dusk;* so one would not expect to find many flying between 9 and 10 o'clock on a night in January. In support of the probability that many were about earlier in the evening, I may mention that a large number of *living* and *freshly-caught* males of the 'Mottled

Umber' were sticking in the grease-bands on the *Apple* trees, where this species seemed most prevalent. We found one hedgerow swarming with males of *H. rupicapraria*, which we all at first sight took for *brumata*; but I secured a few in the cyanide-bottle, and, on making an examination of them with a better light than the lantern gave, I find they are the former species."—(T. D.).



HYBERNIA RUPICAPRARIA.

An examination of the figures of the two species of moths given above will show the great similarity of appearance on general inspection. They are much about the same size, and the females in either case have abortive wings, which, though useless for flying, are still large enough to be clearly noticeable. The male *rupicapraria*, or "Early Moth," is distinguishable, in a general way, by the fore wings being darker, and the hind wings lighter, than those of *brumata*, or Winter Moth.

A little later—on February 20th—Mr. J. Wright (of the 'Journal of Horticulture') wrote me regarding *non*-effect of the long-continued frost on vitality of the eggs experimented on:—"We have recently passed through the longest frost that has been experienced in the South of England for more than 100 years; yet trees with eggs on them placed in heat at Glewstone Court a week or two ago speedily produced a full crop of young caterpillars."—(J. W.).

One of the first notes of appearance of the caterpillar-pests was sent me, on March 26th, by Mr. C. Lee Campbell, of Glewstone Court, Ross, Herefordshire:—"Just a line to say that I commenced my Paris-green spraying yesterday. To-day my gardener reports that he has found three caterpillars at work; so it is time to sound an alarm."

On April 16th, Mr. Hiam, writing from Astwood Bank, near Redditch, noted that "the eggs of the Winter Moth (*Cheimatobia*) are also just coming to hatch on a few small trees which I did not grease-band. Trees properly banded I cannot find an egg on." And on the 25th of the same month, Mr. Henry Martin, Fruit-grower, Bredon, Tewkesbury, wrote me, "We have the Winter Moth hatching out in this district in very large numbers"; and he expressed a hope that by the measures recommended they would be able to keep the pest down.

With regard—more especially—to the experiments, or rather (we may now say) the successful work, that is being carried on in destruction of orchard caterpillars by spraying with Paris-green, as it is unnecessary to take up space again with a mass of reports on the subject, I merely give a few observations this year from well-known authorities to show that the application is still well-proved to be satisfactory and serviceable, *where the directions issued are followed;* and also that the application is being extended usefully to spraying fruit-bushes.

The following note, which was sent me, on July 14th, by Mr. C. D. Wise, from the Toddington Fruit-grounds, Winchcombe, Glos., where, it will be remembered, Paris-green spraying was carried on largely in the previous season, it will be observed speaks markedly not only of the good prospect of Plums, but also of the *particularly healthy* state of their foliage, which is a most important consideration. Mr. Wise wrote to me as follows:—"We have a wonderful prospect of Plums this season; our trees are looking particularly healthy in their foliage. What they would have been if we had not taken all the trouble we did to get rid of insect-pests, it would be impossible to say!"

Later on, Mr. Wise sent me the following note, reporting the enormously lessened amount of appearance of Winter Moths this autumn:—"We commenced grease-banding this year on the 5th October, and we have done just the same as last year, using the grease-proof paper and grease free from pungent oils. Putting on the paper and grease costs us about 6d. per 100 trees labour only. We have seen hardly any of the female moths; in fact, I have not heard of more than six throughout our plantations. This looks as if we had got the upper hand of them at last."

In these notes we have report of the joint good effect of grease-banding at time of moth ascent, and of Paris-green spraying at caterpillar time. In the following observations with which I was favoured by Mr. C. Lee Campbell, of Glewstone Court, near Ross (at my special request, as I was aware he had devoted most careful consideration to the subject), no grease-banding had been used, the successful results were from use of Paris-green. But in each case the point is markedly brought forward, which is not enough considered generally, namely, *that where preventive or remedial measures are properly carried out, we have not only benefit at the time, but the hordes of attackers, being thus enormously lessened, we have so much less to do in the future with fighting their progeny.* Mr. Lee Campbell observed:—

"I have nothing to retract as regards 'Paris-green,' and see no reason to change my views as to the proportion to be used, *viz.*, 1 oz.

to 20 gals. of water. That amount does not injure my Plum foliage, while it kills the caterpillars; and, of course, there is no reason why the same dose should spare the caterpillars on any other foliage. What, then, is the use of employing anything stronger?* The essential is that the liquid be syringed carefully in dull weather, and be constantly and thoroughly stirred *all the time of using*. Very few people yet seem to take any trouble to know whether the eggs are there at all; whereas, if they look carefully, they would find that the hatching-out period extends over three months, which was my reason for syringing ten times over three years ago. The leaves at first, during my apprenticeship, were much burned, but the trees did not seem to suffer; and the next year I had to syringe only three times. This year I have only syringed once, and I finished off the caterpillars by having the trees sharply shaken, and the fowls ate all the pests. My whole field has been a perfect sight this year, as to the Apple trees, and I have had a very satisfactory crop (which, however, was very materially lessened, especially as to Plums and Pears, by the frost of the 16th May). The promise of fruit—in the shape of buds—for next year is splendid.

"As to the danger in using Paris-green, for all practical purposes it is non-existent. Of course, if a deadly poison is handled as one would basic slag, no doubt there is danger; but as I have used it here more intensely probably than anyone else, I am in a position to affirm that only stupidity on the part of the operator can cause any bad results. I should like to be able to report the entire disappearance of the Winter Moth, but, as a matter of fact, he put in his appearance about the same time as last year (Oct. 8th), and my gardener reports that he swarms in the lanes. Mr. Watkins, of Withington, says the same, so that we shall now be very vigilant. So far we have found no eggs and very few moths in my field.

"There is what seems to me an ignorant prejudice against grease-banding. I do not practise it simply because my trees are pyramids, but I am firmly convinced that in spite of some curious anomalies it is the safest thing to do for standing trees; only, the grease must not touch the bark."

The above observation of Mr. Lee Campbell as to absence of eggs and moths on his own land, and prevalence in the lanes, confirms the evidence of benefit from local destruction of the pests. The male

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* This, I think, is a very important consideration. The American and Canadian economic entomologists have repeatedly written to me on the strangeness of the fact that the Plum leafage here should bear such a much stronger application than with them, where, in the words of one correspondent, "it would scorch every leaf off the tree." Therefore, I certainly think that in giving the stronger quantity of 1 oz. of Paris-green to 10 gallons of water, although we have good record of it answering, we are working too near what may prove a danger.

Winter Moths, being winged, may, of course, betake themselves anywhere; but the females, which cannot fly, must, so far as they depend on their sole exertions, walk up the trees, beneath which they have lived in chrysalis-state, and on which they feed as caterpillars; and their absence is a proof of the good which has been done by treatment.—Ed.

The following notes which refer to success in clearing caterpillars from Black Currant leafage, by means of application of Paris-green spray with the "Eclair" knapsack-pump, were sent me, on May 18th, by Mr. John Speir, of Newton Farm, Newton, near Glasgow. Mr. Speir noted that the first of the caterpillars were seen on the 10th, and the next two days, being particularly warm, they appeared in thousands; and that he had "had the 'Eclair' going for two days previously, but, as showers were coming on occasionally, the Paris-green appeared to get washed off, and to do no good. Also, as new leaves were unfolding almost daily, there were always some clean leaves to feed on."

Consequently, however, on this great appearance of caterpillars, Mr. Speir had energetic measures taken; and I give his report *verbatim* as a record of the success of the application on fruit-bushes, and also as the experience of one of our very leading fruit-growers:—

"From Monday morning I kept spraying from 5 a.m. to 8 p.m., using at first 1 lb. to 200 gallons, and latterly 1 lb. to 150 gallons. At first the spraying appeared to have no very great effect on the caterpillars, but about the 14th I saw they were decreasing, and from then till now (18th) they have died off wonderfully. On Monday it was difficult to get a sprig without caterpillars, while to-day few are to be had with them. All my bushes have been gone over once, some twice, and a few three times, and I am going to go on as long as any remain. In only a very few cases have any of the leaves been scorched, and then apparently from the liquid at the bottom of the 'Eclair.' I am also doing the Apple trees, and, although I see I am quite unable to prevent damage to the foliage to a little extent this year, I expect I will be able to very much reduce it by another one, as an enormous crop of chrysalids must be done away with."

On Tuesday, May 12th, during the visit of the Fruit Experimental Committee at Toddington, Mr. Gibbon (Chairman) reported that "he had been spraying his Gooseberries. He observed the sawfly on the Gooseberry bushes, and they sprayed them with Paris-green, and they could not see any left now. They used 1 oz. of Paris-green paste to 12 gallons of water. His trees were looking beautifully healthy."*

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* The above is quoted from the 'Evesham Standard' for May 16th, giving a detailed report of the meeting, as I cannot at this minute lay my hands on a report by Mr. Gibbon on this point amongst his other observations sent me.—E. A. O.

There are difficulties in the way of any new application, but we have plenty of evidence, given in long detail, with the well-known names of the experimenters attached, of the success with which the application can be used; and we have any amount of evidence that there is nothing else which has been found to answer in this country, save this mixture, to make a thorough clearance, at one or two sweeps of spraying, of the *hordes of all the various kinds of caterpillars* which so long have devastated our orchards early in the year at their pleasure. London-purple may very likely be found in time to answer as well, or even better, but as yet we have not such full record of experiment; and this, like Paris-green, is a poison.

Attention to directions necessary for success.—The use of Paris-green has been spreading more widely, and, so far as I can judge from the reports sent me, the spraying is successful where the directions issued are followed. But the difficulty is immense in getting this matter attended to, and consequently trouble arises.

Two years ago the use of Paris-green spraying was almost or quite unknown in England, but since then our own experience has confirmed that of many years of American application in showing the success, WHERE USED ACCORDING TO DIRECTIONS; and the following list of disasters and their causes, arising simply from non-attention to directions, which has been placed in my hands by a well-known fruit-grower, is eminently instructive. I give it throughout almost in his own words, and append to each paragraph of it extracts from my own pamphlet on the use of Paris-green, to show how in every case attention to the "Directions" quoted from it would have saved the disasters.

Difficulties noticed. 1*st.* "*I find that growers, when confronted with a strong attack of the caterpillar, get impatient to destroy them, and use the Paris-green in a stronger proportion than what is recommended.*"

DIRECTIONS.—"The amount of Paris-green found serviceable by the Evesham Fruit Pests Committee, and which they decided they could recommend, was:—Paris-green paste in the proportion of 1 oz. to 8 or 10 gallons of water for Plums;* and 1 oz. to 20 gallons of water for Apples. Apple leafage was found to be more tender than that of Plums. Pear leafage should be treated like that of Apple.

"For Currants the strength found safe was the same as for Plums —1 oz. of 'green' to 10 gallons of water; but as the foliage grew stronger, 1 oz. to 8 gallons of water was found not too strong. Neither of these strengths of mixture damaged the leafage, but they killed the caterpillar.

"Capt. Corbett, the Superintendent of the Toddington Fruit

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* See note regarding safe strength for Plums at p. 71.

Grounds, writing to me on the 3rd of July, 1890, and mentioning his satisfaction with the results of spraying, also noted, 'The proportions I fixed upon after the first trials, *viz.*, 1 oz. to 10 gallons of water for Plums, and 1 oz. to 20 gallons of water for Apples, must not be exceeded.'

"'Insist upon the mixture not being made too strong; 1 lb. to 200 gallons I find very useful, and I never use stronger than 1 lb. to 120 gallons.'—(J. F.). Advice sent by the Entomologist of the Dominion of Canada."

Difficulty 2nd. "*I find that even when the Paris-green is used in the proportion of* 1 *oz. to* 10 *gallons of water, unless the operator is judicious and careful, the foliage of the trees will get injured. This would arise from the particles of the Paris-green settling at the bottom of the vessel during the time it is being applied, so that the effect in such case would be that one portion of the solution is too weak to accomplish any object, and the portion at the bottom of the vessel would be disproportionately strong and dangerous. So that care should be used in putting solution in general commotion every few minutes, so as to avoid the Paris-green settling.*"

DIRECTIONS.—"In application of Paris-green sprayings, it must always be borne in mind that, whatever kind of engine or spraying machine is used, the mixture must be kept an even strength throughout, and no sediment allowed to form at the bottom, or damage to the leafage is sure to happen.

"On these points Mr. Fletcher, the Dominion Entomologist of Canada, wrote to me as follows, and also enforcing care as to over-application:—

"'*Paris-green.*—You are quite safe in recommending this; but insist upon these two things, *viz.*, 1st, to keep the mixture (which is a mixture, not a solution) well stirred all the time, and have the barrel well washed out after it has been filled ten or twelve times. The Paris-green is very heavy, and will keep sinking to the bottom unless constantly agitated; and as the barrel is frequently re-filled the residue will keep accumulating, until it will be too strong as the mixture reaches the bottom.'"

Difficulty 3rd. "*Another danger arises from the operator, 1stly, putting on the solution too copiously. Great care should be used in securing the best sprayer; the 'Eclair' I have found the best. 2ndly, to be careful that the foliage of the trees is only bedewed or well-misted. If a quart of the fluid is used in suffusing a tree when a pint would be adequate to destroy caterpillar-life, your excessive quantity of fluid used would be equivalent to the using of an extra quantity of Paris-green.*"

DIRECTIONS.—"With regard to method of application of the spray. This should be thrown so finely as to reach all parts of the tree and both sides of the leaves, and coat the leaves as with a fine dew, but it should *not* be allowed to run down and drip. As soon as dripping begins spraying should cease.

"It should on no account whatever be thrown so as to 'swill' or 'souse' the trees, and run off the leaves in drops or streams; this is bad practice in every way. It uses a great deal more of the chemical than is needed; the leaves get little but pure water at their highest part, and much too strong application where the fluid has settled at the tips; and also a drip is caused on to the ground beneath, which may render the grass temporarily poisonous,

"Also, spraying should not be done whilst the trees are in blossom, and warning is also given in the American works that sprayings should not be given in rapid succession. Several days, it is advised, should elapse between, unless, of course, as may easily happen in difficulties of first experiments, the spray was manifestly so weak that the previous application counted for nothing. The effect of the Paris-green on the caterpillars does not always show directly, and it is undesirable to waste labour and material where the work is already done, and only requires a day or two to show it."

The above difficulties, it will be seen, are what are most carefully pointed out in the "Directions," as the details regarding which care *must* be taken to ensure success, and the requisite points to the end are most fully laid down in my own short pamphlet on the application of Paris-green, from which I have given the extracts of directions. I am only happy to send to any applicant who wishes for it for practical orchard or fruit-growing purposes, or it is procurable per dozen or hundred from my publishers.*

To the above extracts I add the following with regard to the care which, with this arsenite of copper, as well as with all other poisonous preparations applied in farm or orchard service, must be exercised in its use:—

DIRECTIONS.—"The cautions to be observed in the use of Paris-green are:—The bags should be labelled Poison and kept locked up, and especially kept safely out of the way of children, who might be attracted by the beautiful green colour of the powder.

"Workers with the powder should not allow it to settle in any sore or crack in the skin of the hands, nor stir it about unnecessarily with the hands; and they should be *very careful not to breathe in the powder* through mouth or nose whilst measuring or mixing it; *and stock and other animals should never be allowed to pasture or feed under trees that are* season as to how far it might be serviceable and practicable to use Paris-green and soft-soap together. *This matter of soft-soap and Paris-green* mixture was a subject of great importance, and I was not able myself to offer any trustworthy opinion as to chemical changes which might take place in such a mixture, or how (if these changes took place) the mixture resulting might affect plant-leafage, I applied for information to our excellent authority, Dr. J. Aug. Voelcker, Consulting Chemist of the Royal Agricultural Society of England. He kindly gave me the following clear account of the changes which occur to Paris-green when acted on by an alkali variously applied; some serviceable remarks as to extent of change depending on amount of free alkali, and strength of the soft-soap solution; and likewise the result of the experiments which he was good enough to make by way of practical test, which information, with his kind permission, I give *verbatim* :—

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* 'Paris-green or Emerald-green: its uses, and methods for its application as a means of destruction of Orchard Moth Caterpillars.' Demy 8vo. Price 1s. 6d. per doz.; 8s. 6d. per 100. Published by Messrs. Simpkin & Co., Stationers' Hall Court, London, E.C.

" Aceto-arsenite of copper (Emerald-, or, as now called, Paris-green), whilst it is insoluble in water, is acted upon both by acids and alkalies, with the result that copper is thrown out. With an alkali a blue precipitate of cupric hydrate is first formed, and if this be *boiled* with the solution it changes to the black cupric, and then to the red oxide.

" Now, whether this takes place with mixing soft-soap solution and Paris-green depends mainly upon what amount of free alkali is present, and what the strength of the soap solution be. *Theoretically* there should be *some* separation, inasmuch as soft-soap always has some alkali.

" I thought, therefore, the best way was to make a practical test in my laboratory before writing to you, and this I have done, and may now give you the result thus :—If a very strong (28 lbs. soap in 10 gallons of water) solution be used, there is a certain amount of change; but if a solution of lesser strength, and more like the one recommended for Hop-washing purposes (28 lbs. in *100* gallons) be used, there is no appreciable change."—A. J. V.

The above gives very clear information available for practical use, as to addition of Paris-green to soft-soap in solution; but further we needed information on conditions of mixture in solid form, that is, of Paris-green added to soft-soap itself, forming a kind of paste to be dissolved in water for use.

Regarding this, Dr. Voelcker further wrote me, on the 17th April, mentioning that, from my letter received that morning, he concluded that a mixture regarding which I wrote was soft-soap and Paris-green, not merely making a solution of the soap, and to that weak solution to add the Paris-green; and of this he observed :—" Now this is to my mind distinctly open to objection, and I should not countenance it on several grounds. If one mixes soft-soap direct (and in weak solution with water) with Paris-green, you get a *decidedly alkaline* mixture, and the circumstances thereby induced which would tend to cause the copper (as explained in my last note) to be partly thrown down. It might not happen in a weak solution, but would be much more likely to do so if soap and Paris-green were directly mixed.

"The remark in your letter as to the change of colour you noticed in the outside portion makes me think that partial reduction has actually taken place, and if so, that means a change of composition. I have to-day made such a mixture, and will keep it to see what happens.

"But there is yet another great objection: the soft-soap may simply be a cheap medium for 'wrapping up' in it a *little* Paris-green, and making it look a *lot*. If the purchaser wants such a mixture he had better get the separate materials himself and mix them; then he may have a fair chance of getting the right amount of 'green,' otherwise he will not.

"Lastly, the mixture is a difficult one to mix up in water, at least in cold water. I would certainly advocate the 'unmixed' material for purchase."—A. J. V.

The above-mentioned experiment Dr. Voelcker carried out, and on April 28th further wrote:—"I have now kept the mixture of Paris-green and soft-soap, which I made for some time, and have compared it with the tin of the similar compound which you sent me.

"The appearance which the two present are identical.

"As I said to you before, there is a change to a certain extent in the composition, which is indicated by the darkening of colour noticed by you, and called by you the olive-greenish colour." . . . . . Dr. Voelcker made some observations here in reply to remarks on various colouring which I had noted, and then proceeded:—"That there has been a change is quite enough to make the application of the term 'Paris-green' not altogether a proper one, for it is no longer the aceto-arsenite of copper. Whether, however, its properties are destroyed or not is another matter, and, seeing that the evidence we have so far goes to show that any salt of copper acts as a preventive against mildew, one cannot say that the mixture has produced a body no longer possessing the virtues of the copper compound." . . . . "The mixture of soft-soap does not remove the copper, nor yet the arsenic; they both remain there." . . . . . After some further observations, Dr. Voelcker added:—"And again I call the mixture a very bad one for mixing up with water; it is a sticky, pasty mass that wants a lot of rubbing about; ordinary stirring in water does not do. It would be much better to stir the pure Paris-green up in a soft-soap solution. I see no advantage, but rather disadvantage, therefore, in the use of the mixture."—A. J. V.

The above clear observations of Dr. Voelcker's require no comment; and I felt myself much favoured in being thus aided to place the exact state of the case regarding admixture of Paris-green and soft-soap before those to whom a certain knowledge of what they are dealing with is of great importance. With regard to the mixture itself, I can quite endorse Dr. Voelcker's views as to its being a tenacious sticky mass most difficult to deal with, and also involving great uncertainty as to proportion of Paris-green therein contained. Consequently there may be more or there may be less than the quantity needed, and great difficulty or loss ensue. In these observations the matter under consideration was solely mixture of Paris-green with soft-soap.

About the same time, being then in correspondence with Mr. James Fletcher, the Entomologist of the Dominion of Canada, who assisted us greatly in the first trials of use of Paris-green in England, I mentioned the subject, and he subsequently favoured me with the following notes of experiments carried out by Mr. Frank Shute, the Chemist of the Experimental Farms of the Dominion of Canada. These (which, it will be seen, especially regard whether the poisonous action of the Paris-green is changed by mixture with solution) deal with chemical changes, or changes in condition, which are caused to Paris-green by various combinations specified; also give notes of results of experiment of mixtures of Paris-green with various kinds of soaps, alkaline, or not alkaline to test paper; and notes of the inferences to be drawn from the experiments. I beg here also to express my best thanks for the favour of being permitted to offer such useful information for general service; and I give the report as follows:—

"Laboratory, Central Exp. Farm, Ottawa, Canada,
"June 9th, 1891.

"*The application of Paris-green in soft-soap solution as an insecticide.*—The question has arisen whether the toxic action of Paris-green as an insecticide is to any extent weakened or destroyed when the poison is applied with soap solution. For the purpose of answering this question I have carried out a number of laboratory experiments, the results of which form the basis of the present report.

"Paris-green (aceto-arsenite of copper) is an emerald-green salt, which is *practically insoluble in water*. Experiment 1 consisted in shaking up Paris-green with water constantly for more than a week. The Paris-green was then filtered off. Not a trace of arsenic could be detected in the filtrate, though the most delicate chemical process was employed.

"Strong ammonia readily and completely dissolves Paris-green, forming a deep blue solution, and capable of being diluted with water without decomposition or precipitation.

"The fixed alkalies, potash and soda, in strong aqueous solution decompose this poison, the blue hydrate of copper separating. This on heating first becomes changed into the black oxide, and finally the red cuprous oxide, the arsenic going into the solution as potassium arsenite.

"A number of experiments have been tried as to the solvent action of different soap solutions on this insecticide. The soaps used were (1), whale-oil soap; (2), common brown soap; (3), 'English' soft-soap.

"The whale-oil soap strength (1 lb. to 8 gallons of water) was not alkaline to test paper. The Paris-green was shaken up with this solution repeatedly for five days, and the mixture then filtered. Not a trace of arsenic could be detected in the filtrate, showing that no decomposition of the Paris-green had taken place. The latter retained its bright green appearance throughout the experiment.

"The solutions of the 'common brown' soap, and 'English' soft-soap, were not of any stated strength, but were as strong as it was possible to make them. By this means, a severe and extreme test was made in each case.

"The common brown soap was strongly alkaline. Its solution was found to *slightly* decompose the Paris-green, arsenic being detected in the filtrate in *traces* after acting upon it for five days. The residual Paris-green was, however, bright green, which, together with the fact that but traces of arsensic passed into solution, shows that only to a very slight degree had the poison been acted upon.

"With the 'English' soft-soap solution, which was much more strongly alkaline than the preceding, there was more decomposition, *i. e.*, more arsenic passed into solution, and more copper precipitated, than in the experiment just cited. The treatment was similar as in the previous trials, and the result showed that heavy *traces* of arsenic had passed into solution, while at the same time a slight brown deposit of oxide of copper was to be noticed on the residual Paris-green.

"If it were necessary for the efficacy of the poison that the Paris-green be applied in such liquids as would have no decomposing or solvent action upon it, the results of these experiments show that no practical harm or deterioration would result from using it with soap solution. When it is remembered, however, that Paris-green, though insoluble in water, passes, more or less rapidly, into solution by the action of the digestive fluids before its toxic effects can be conveyed throughout the insect's body by the circulatory system, there seems to be no good ground for condemning an application in which traces of arsenic are already soluble. The chief reason against the use of white arsenic, is on account of its injurious effect on foliage, it being soluble in water and acid in its character.

"The arsenic set free in the soap solution is neutralized by the free alkali of the soap, so that where soap solution can be used *per se* without harm, no injurious results from soluble arsenic need be apprehended when to it is added Paris-green in the right proportions.

"In all the above experiments the soap solution was at the ordinary temperature of the atmosphere when added to the Paris-green. If heat had been used undoubtedly a larger portion of arsenic would have gone into solution."—FRANK T. SHUTT, M.A., F.I.C., F.C.S., Chemist, Dom. Expl. Farms.

PLUM.

Plum Sawfly. (For scientific names, see note, p. 84.)

During the past season, I received from a few different localities specimens of young Plums infested by Sawfly grubs, which were obviously doing much mischief by clearing out the young kernel, and sometimes further injuring the centre of the fruit, and consequently causing it to fall very prematurely.

On the 22nd of June, I received a communication from the Rev. Henry H. Slater (Urchester Vicarage, Wellingborough), mentioning that his Plums were heavily attacked by a grub which he was not able to identify, and he therefore forwarded a few of the fruit for examination. He remarked:—"It appears to me that the attack has been made and the eggs introduced very shortly after flowering, because, when the puncture occurs at the extreme end of the fruit, the exuding gum has often fixed the remains of the flower. I should say that the creature has injured quite half the crop."

The injured Plums varied in size from about, or a little over, half-inch to an inch in length. In somewhere about nineteen examined, I found the fruit usually to have one boring near the end opposite to the insertion of the stem. In a few cases there were two injured spots; the tunnels were sometimes open, sometimes choked with black gummy material.

On opening the fruit I found the kernel gone, and often some amount of marks of gnawing round the cavity where the kernel had lain; this cavity being more or less filled with blackish decayed matter.

The larva was rarely present in any of the fruits which I opened sent me by Mr. Slater, but, where present (either amongst these or amongst the specimens sent me from Toddington), I found them to be twenty-footed caterpillars. That is to say, they were furnished with three pairs of claw-feet; six pairs of ventral sucker-feet; and one pair of sucker-feet at the end of the tail; ten pairs in all.

The general colour of the larva or caterpillar was whitish; head chestnut, darker in front or on the jaws; eyes dark or black. In such specimens as I examined, the caterpillar lay curled in the injured fruit, somewhat in the manner of a Cockchafer grub, but when disturbed and placed on the hand, it walked swiftly along it. On further examination a few days later, I found the length of the specimen (exactly measured) was five-sixteenths of an inch,—the head pale chestnut, general colour yellowish, the shape somewhat pointed towards the tail, and also it *emitted a strong smell*.

About the 22nd of June some Plums, similarly infested by Sawfly caterpillar, were forwarded to me from Toddington (Gloucester), by Mr. C. D. Wise. He mentioned, "We picked the Plums and destroyed them"; and on the 14th of July he further observed:—"I am sorry we could not let you have any more fruit of the Plum with the caterpillar still in, as after your letter we were unable to find any more; by this you will see our attack was not severe, and the grub must have been about full grown when we sent it to you. I do not find that the Plum Borers attack any special kind of Plum more than another." The infestation was also stated to be bad in the Evesham district.

Presumably the plan mentioned above by Mr. Wise would answer excellently for preventing recurrence of the attack, as thus the caterpillars would be destroyed before they had the opportunity of burying themselves, and going through their changes to the perfect Sawfly. These good results are shown in the following extract from a letter sent me on the 29th of June, from Seaford Grange, Pershore, by Mr. W. F. Gibbon (Chairman of the Evesham Fruit Growers' Experimental Committee):—"Regarding the Sawfly larvæ in the young Plums. Last year I noticed a lot of them, and had all the dropped Plums daily gathered up and burnt. This year I find a bored Plum dropped only here and there."—(W. F. G.)

In the case of this infestation, I have merely distinguished it by the name of "Plum Sawfly," as I have only had the opportunity of studying the larvæ during a short part of their lives; in all points, however, which I had opportunity of observing, the condition of the Plums and the appearance of the caterpillars corresponded with the long and full accounts of Plum Sawfly given respectively by Dr. Taschenberg, Dr. Ritzema Bos, and also by Canon Schmidberger, under different scientific appellations, thereby adding not a little to the perplexities of the subject.*

The life-history of the Plum Sawfly, as given by the above writers, is, in its main points, as follows. The female Sawfly begins her operations by making a slit in a calyx leaf of a Plum blossom, or expanding bud. Apparently only one egg is laid in each blossom (or rather calyx). The egg is very small, geenish white, and transparent. The caterpillar hatches in from about a week to a fortnight's time, and eats its way into the young embryo fruit, where it continues within what would have been the kernel, and when it has consumed all that suits its purpose for food in one Plum goes on to another. This caterpillar is (as we observe of our own) twenty-footed. The colour whitish, or with a reddish-yellow tinge; head dark brown or yellow; body lesser towards the hinder extremity, and it gives out a strong bug-like smell.

The caterpillar is full grown in a period variously observed as from three to four, or five to six, weeks. Then the young Plum falls, the caterpillar creeps out, buries itself in the ground, where it spins a cocoon; here it is stated to spend the winter, still in the larval state, and in spring to change to the chrysalis or pupal state, from which the perfect Sawfly comes out in time to lay her eggs amongst the opening Plum blossoms. The flies are somewhat like the Apple Sawfly, figured at page 1, with two pairs of transparent wings. The general colour black or shining black; legs mostly yellow, or of a reddish or brown yellow.

The above notes of life-history are taken from the observations of Dr. Taschenberg, Dr. Ritzema Bos, and Canon Schmidberger, published in their respective works referred to above.

Means of prevention and remedy (also given by the same observers) consist, for one thing, in collecting and destroying the infested little

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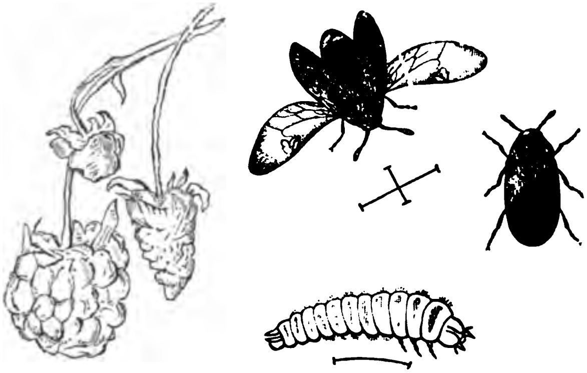
* In the 'Praktische Insekten-Kunde' of Dr. Taschenberg, the name given is that of *Hoplocampa fulvicornis*, Klug.; in the 'Tierische Schadlinge und Nützlinge' of Dr. Ritzema Bos, it is *Selandria fulvicornis*, Klug., and the internal evidence of quotation in each of these papers shows it to be the same insect of which a very good account is given by Schmidberger in 'Kollar's Insects,' under the name of *Tenthredo morio*, Fab. A short account of the infestation corresponding with the above, so far as a few lines can correspond with full descriptions, is also given in Kaltenback's 'Pflanzenfeinde' under the name of *Selandria fulvicornis*, Klug. It is, however, very requisite, in mention of the *Tenthredo morio*, Fab., to mention also the name of the authority by whom it is so called, as the *Selandria*=*Tenthredo morio*, Fab., of Cameron's 'Mon. of the British Phytophagous Hymenoptera' (vol. i. p. 199), and the *S. morio*, Fab., of Taschenberg's 'Insekten-Kunde,' are clearly different insects from the *T. morio* of Schmidberger, inasmuch as the caterpillar is stated to have a green body spotted with black, whereas the colour of the caterpillar of the kind described above is whitish or yellowish.

Plums before the caterpillar within can leave them to bury itself. This may be done by jarring or shaking the trees, so as to cause the damaged fruit to fall, and having this fruit immediately gathered together and destroyed before the grub within escapes. Or the infested fruit may be picked from the trees by choosing such of the little unripe Plums as show a black spot, where the sap and black rejected matter from the grub have run down its tunnel and show at the outside.

Also it is stated that the black Sawflies are sluggish, and when they are occupied in egg-laying, or in sucking honey from the Plum blossoms, that they may be caught by hand where they are in reach on low-growing trees.

RASPBERRY.

Raspberry Beetle. *Byturus tomentosus*, F.



BYTURUS TOMENTOSUS.

Raspberry Beetles, much magnified, with line showing nat. length; maggot, magnified, with line showing nat. length, after sketch by Prof. Westwood. Raspberry fruit.

The *Byturus tomentosus* is a small beetle of some shade of brown, which may vary from pitchy to reddish or yellowish, but covered with such a thick yellowish or grey down as to conceal the ground colour. The horns (which are thickened towards the extremity so as to be somewhat club-shaped) and the legs are reddish yellow, or reddish yellow with a brown tinge.

These beetles are to be found in spring (after they have developed from the chrysalis state) infesting various kinds of flowers, but especially those of Raspberries. Here they do an immense amount of mischief when they are numerous, as was the case last year in Raspberry plantations, but this was not all. The female beetles lay their eggs by the still slightly developed Raspberry fruit, and the maggots, which presently hatch from these eggs, feed on the fruit until it and they both reach maturity, and the fruit, if not totally destroyed, is at least made unfit for use. The maggots grow to a length of about a quarter or five-eighths of an inch, and are cylindrical, somewhat depressed in front, and lessened at the hinder extremity, which is "terminated above by two brown curved points, and beneath with a cylindrical tubercle employed as a proleg." They have three pairs of moderately long, hairy feet. The colour is yellowish with brownish yellow on the back, the head brown.

When the Raspberries are ripe, the maggots leave the fruit and seek for some cranny under the bark, or in the wood of the Raspberry stem, or some similar sheltering-place, where they form a cocoon or case in which they turn to the pupal state, in which they pass the winter, and from which the beetles come out in the following spring to attack the Raspberry blossoms.*

This attack is one which, like many other of the fruit insect attacks, is either steadily increasing both in area and amount of damage caused by it, together with the increasing area of fruit crops grown year by year on one spot, or is much more noticed than was formerly the case. In the course of my fifteen years reporting, I have only once before (in 1883) received observations regarding the infestation which pointed to it as one of serious moment; and now it will be seen by the following notes that the attack was present in its beetle form very noticeably in the great Toddington Fruit Grounds, and in various localities in Kent. It was also reported from one locality in Essex, one in Herts, and one in Cambridgeshire, and also from the well-known fruit grounds of Mr. Speir, near Glasgow, and from the east of Perthshire.

In the past season, the first notice I received of this infestation being present, was sent me on the 26th of May, by Mr. J. Green, fruit grower, of March (Cambridgeshire), who forwarded specimens of the *B. tomentosus*, with the remark that they were sent as "samples of a Raspberry beetle which is doing damage to the Raspberry crop in this neighbourhood this spring. You will notice from the buds, also enclosed, the manner in which the damage is being done."

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* The above description of the larval state of the *B. tomentosus* is taken from collation of the accounts given respectively by Prof. Westwood, in his 'Classification of British Insects,' Dr. Ritzema Bos, in his 'Tierische Schadlinge und Nützlinge,' and Dr. E. L. Taschenberg, in his 'Praktische Insekten-Kunde,' as I have only personal knowledge of the *Byturus* larvæ in their full-grown state in the ruined Raspberry fruit.

On June 1st, specimens were sent by Mr. J. Temple Johnson, from Sutton Court, Dartford, with the note, "I enclose some small brown beetles, and some Raspberry blossoms injured by the same. These beetles are very numerous this year"; and a few days later a further supply of the beetles were forwarded, together with Raspberry blossom in various stages of consumption, and the further observation, "You will see that it is quite finished off, and if some remedy is not found the whole crop will be destroyed."

On the 3rd of June, Mr. C. D. Wise noted of this same beetle, that they were feeding in quantities on the Raspberries in the Toddington Fruit Grounds (near Winchcombe, Gloucester), and observed on its habit of feeding by day as a distinction between this and the night-feeding Raspberry weevils, which at first it was feared they might be. On the 11th of June Mr. Wise wrote me with regard to remedial measures, "We have been shaking the bushes over bags soaked in paraffin with excellent effect."

The same attack was noted by Mr. P. R. Morse, of Wickham, Bishop Witham, Essex, on June 8th, as that of a little beetle that attacks the bloom of the Raspberries, and appears, in some instances, quite to destroy it. Mr. Morse observed that it was found quite at the bottom of the bloom where the fruit is forming, and that he heard it was very general in Kent; but with him, and from what he could learn, it was not doing so much harm as the Kentish attack. About a week later, Mr. Morse wrote:—"I do not find so many of the Raspberry Beetles now, and do not think they will do me much harm this year at any rate."

From Halstead, Sevenoaks, on the 12th of June, they were reported by Mr. W. Bowen as "insects that are very troublesome in our Raspberry plantations, and doing very great damage just now"; and from Knockholt, also near Sevenoaks, in Kent, Mr. James Wood forwarded me specimens of the *Byturus*, and also of the *Otiorhynchus picipes*, the "Clay-coloured" Raspberry Weevil, as samples of the insects "which have caused so much damage in our Raspberry and Strawberry plantations. Mr. Wood remarked, "I have been a grower for this last twenty-five years, and during that time have never known so much destruction before." Notes of another locality of Kentish attack of this kind of beetle were also sent by Mr. W. L. Wigan, from near Maidstone, with specimens accompanying, and the observation, "There are sometimes five in one flower. They fly readily; they lie in the trough round the base of the embryo fruit."

From Much Hadham, Ware, Herts, the following good note of method of attack of the beetles on the buds was sent me on the 17th of June, by Mr. M. L. Gayton:—"They are doing much damage to a small garden Raspberry plantation. I first noticed them when the flower-buds were forming; apparently piercing a hole in each bud. Now as the buds are opening, they seem to be eating the stamens and petals. I have killed quite two hundred in a short time, generally two on every bud."

From much further north, namely, from Newton Farm, near Glasgow, Mr. John Speir sent me specimens, on the 18th of June, with the remark that "the enclosed small brown beetles are making considerable havoc on the remaining canes of my Raspberries. They eat away the flower-bud." Various localities also in west Perthshire apparently suffered from the same trouble, as on the 30th of June, Sir James T. Stewart Richardson, of Pitfour Castle, near Perth, directed my attention to complaints, then appearing in the 'Dundee Courier' from district correspondents, regarding a very destructive beetle which had attacked the Raspberry. Two of the localities where the infestation was reported as being injurious were the neighbourhoods of Scone, which is a few miles from Perth, and Alyth, on the border of Perthshire and Forfar. As I had not (as in all the other cases of this infestation) specimens sent me for examination, I cannot be certain that this attack was of the *Byturus tomentosus*, but as the attack was described as of a voracious little black beetle, which fed on the Raspberry blossom, it is presumable it was of this kind.

All the above observations, it will be noticed, refer to the attack of the *Byturus* beetle to the flower or blossom bud of the Raspberry, the first application being sent on the 26th of May, and enquiries or remarks on presence of attack being continued until the last day of June. This injury, however, which is caused by the beetles to the blossoms is only one portion of the mischief. Following on this is the harm done by the maggot in the Raspberry fruit. Of this I received very thorough examples from Toddington, sent me by Mr. Wise on the 19th of August with the following observations :—

"I am sending you some Raspberries which will, I fear, arrive in a pulp, but at this time of year they are so very soft. In them you will find a quantity of grubs, and our Raspberries are infested with them. Can you tell me what they are ?"

These I carefully identified from descriptions as being maggots of the *Byturus* beetles of which so many had been seen earlier in the year, and of which the chief characteristics are given at pp. 85 and 86, and on forwarding the information received the following confirmatory note from Mr. Wise :—

"I looked out the Raspberry Beetle, on the evening I sent you the grub, in your Report of 1888, and thought they were our old friends. I think they are more plentiful this year than I have ever seen them, and you will remember in the spring of the year we were very much troubled with the beetle."

Presumably a little search into the cause of damage would have shown plenty of "Raspberry maggot" present at other infested localities, but no other specimens of this part of the attack were sent me.

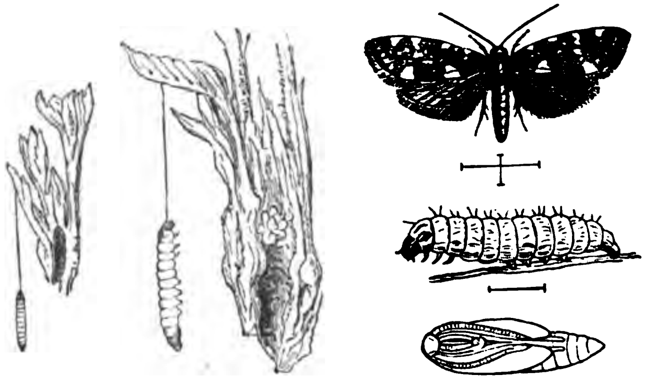
PREVENTION AND REMEDIES. — The most available method appears to be shaking off the beetles in such a manner that they may have no chance of escaping and flying back to the Raspberry blossoms, and no better plan appears to be mentioned anywhere than that mentioned by Mr. Wise at p. 87, of shaking the infested bushes over bags soaked in paraffin oil. Anything (as for instance, cloths, tarred boards, or baskets tarred inside) into which the beetles would fall, and from which they could not escape (whether from being poisoned or stuck fast), would answer well. But in any case the operations should be carried on early in the morning, or when the beetles will be dull and sluggish. "On hot days these little beetles fly away directly they are alarmed."

If it were possible to have the fruit, which from its ruined condition is noticeably infested by the maggots, gathered and burnt, this would save much recurrence of attack. The only other available methods of prevention appear to be—1stly, so clearing away all old wood, and places in which the chrysalids may be sheltered, that they may thus be got rid, or, to a great measure, got rid of at the bushes. But, 2ndly, though I do not see this plan has as yet been brought forward, it seems not unlikely that, as these little chrysalis-cases are stated to be formed in crannies under the bark, or in the wood of the Raspberry-stems, there may be many hidden about the bearing-stems of the past season which are regularly cut away in course of ordinary treatment. If so (unless these trimmings are destroyed), the beetles which come out from them in spring would be a most fertile source of infestation to the neighbouring blossoms. As in any case the old bearing wood must be cut away, it would add little to expense (where this is not already practised) to burn it, and it might be that this would strike at the root of much further mischief.

Red-bud Caterpillar. *Lampronia rubiella*, Bjerk.

The mischief caused by this attack may be readily known from that caused by the *Byturus* beetle and its maggot, mentioned in the foregoing paper, by reason of it affecting the inside of the young buds, or shoots, or pith, whilst the beetle attacks the Raspberry blossom, and the beetle maggots afterwards are to be found in the fruit.

The "Raspberry-bud" moth caterpillars are about a quarter of an inch long, of some shade of red, with black head, and black mark on the following segment; they have three pairs of claw-feet, which are black, and also four pairs of sucker-feet, and a pair at the end of the tail. When examined through a magnifying glass it will be seen that there is a pale line down the centre of the black head, and that the mark on the following segment is composed of a pair of double-spots.



LAMPRONIA RUBIELLA.

Moth, magnified, and with lines showing nat. size; caterpillars, nat. size, and somewhat magnified from life; caterpillar and chrysalis, greatly magnified, after Prof. J. O. Westwood in 'Gardeners' Chron.' for 1853, p. 757.

The attack is begun in spring by the little caterpillars (which live in the caterpillar state through the winter) piercing into the young buds, and with the advance of the season the mischief becomes very noticeable by the fading of the young shoots which have not been destroyed whilst still in bud condition. The infestation was described many years ago by Prof. J. O. Westwood, in the volume of the 'Gardeners' Chron.' for 1858, with good illustrations, from which I borrow the characteristic figures of the caterpillar and chrysalis, much magnified, given above. Of late years it has been occasionally noticed, but I have never received any special report of it since 1888 until its mischievous outbreaks in the past season, which have given opportunity of adding very serviceable information to the previous observation of its life-history.

Some of the first observations of the presence of the caterpillar were sent in last season much about the same time from Toddington in Gloucestershire, and from near Glasgow, and from Crieff in Scotland.

On the 2nd of May, Mr. Wise wrote from Toddington, "I am sorry to say the red maggot in the Raspberry is increasing in an ALARMING extent in spite of our picking off all we could last season."

The specimens sent me in infested buds corresponded with description of the larvæ of the *L. rubiella*, and later on I received a specimen of this moth bred by Mr. Doeg, of Evesham, from larvæ taken in Raspberry shoots at Charlton, belonging to Mr. John Swift. On the 6th of May, Mr. Wise wrote me, "We have picked off every shoot which was affected."

On the 30th of April Mr. Speir, writing from Newton Farm, Newton, near Glasgow, observed:—"On my Raspberry canes to-day, I came on a large number of small scarlet maggots on almost every other cane. They are about three-sixteenths of an inch long, and one-twentieth thick. It has a black head and a small black spot on its tail, but otherwise is all bright red. Up until a couple of days ago, we have had no mild weather since February, much less warm weather, and it is only within that time that the buds have swelled any. Most of these maggots I found crawling on the canes, but quite a number were just emerging from the buds, and on cutting off a number of buds, I found either a burrow from the base to the apex, or a maggot in the base, in a great many of them."

The above observation of Mr. Speir's, regarding the fact of maggots being emerging from the buds is very important practically, as showing the successive injuries which are caused by one caterpillar, and this is fully confirmed by the following note sent me by Mr. Wise on the 6th of May:—

"I am much obliged to you for sending your Report for 1888. I do not agree with Mr. Weir, on page 67, when he states 'that in no case were the caterpillars found to leave the bud which had been attacked, each caterpillar only destroying one shoot.' I have found in cases where there are two shoots the caterpillar has been in one and left it, and evidently gone into the next, for in the next I have found it."

On May 7th the Rev. W. P. Paterson, writing from The Manse, Crieff, N.B., forwarded me specimens of the red maggots with black heads, and mark on next segment, and at tail, of the *Lampronia rubiella*. The buds on the pieces of cane accompanying were not nearly so far advanced in growth as those sent from Toddington, and in one instance I found the red caterpillar well down at the bottom of the bud as described below. Mr. Paterson, after mentioning severe injury from some kind of insect attack which in the previous year reduced the yield of an acre of "rasps" from £40 to £8, further observed:—"On examining the plantation to-day, I find most of the buds eaten like specimen (1), in which, in a few cases, a red maggot (specimen 2) was found snugly ensconced at the root of the bud. I suspect that the crop is again destroyed."

Somewhat later on Mr. Paterson favoured me with the following further communication, which is well worth study, regarding the point alluded to in above observations. Mr. Paterson remarked:—"On page 67 a correspondent informs you that the larvæ entered the shoots when about an inch long. Here many of the buds have been entered when they have barely stirred (specimen 1). He says further, 'that as far as can be seen each caterpillar only destroys one shoot.' I doubt this, while I believe that the caterpillar does not leave the bud when once he has penetrated to the pith of the cane, where he makes his lair; I think that he may often nibble at one or two buds on his way up the cane, and thus destroys them before finding one which pleases him as a permanent settlement. Specimen 2 shows three lower buds which have been seriously bitten, while the only nest is in the fourth or topmost bud.

"I have also seen a caterpillar travelling from a bud, out of which the heart had been eaten, to one higher up, in which he buried himself. I cannot say that I saw him emerge from the lower one, but the traces of damage were quite fresh. In some cases I have found that the cane died away above the joint at which the caterpillar had made his bed in the pith."

The above notes are well worth attention, for in them, from one or other of three observers of Raspberry growing on a large scale, we have information of the little red caterpillars being observable straying about the canes as soon as growth of the buds begins, and of their power of causing damage, not only by an individual maggot establishing itself in a bud, but also by each maggot trying, as it were, successive buds until it finds one to its fancy, and even then if supplies fail, quitting the destroyed bud for a new home.

The following note was sent me, on the 12th of May, from Preston Farm, Shoreham, Sevenoaks, Kent, by Mr. J. Beale, with specimens of both the Raspberry (*Byturus*) Beetle, and of the caterpillars of the *L. rubiella*, the Raspberry Moth. Of the latter Mr. Beale observed:—

"I do not think it is anything fresh, but it is the first time I have observed it. In fact I thought it was the frost that had touched the shoots, till a friend from St. Mary Cray came down and showed me the larva in the shoots; he told me he had some ten to fifteen acres so badly damaged that they looked as if it might be the middle of winter. I am having the affected shoots picked off and burnt." *

On May 18th Mr. E. Vincent V. Wheeler, of Newnham Court, Tenbury, Worcestershire, forwarded me specimens of the *L. rubiella* caterpillars then beginning to spin up and change to the chrysalis state. Mr. Wheeler wrote:—"I am sending you specimens of a small red caterpillar which is attacking the Raspberries this year, it has eaten all the first buds, and eats its way into the cane itself. We have not noticed them in previous years, and should be glad if you could give us any information."

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* Mr. Beale also noticed the great number of the beetles (of which he sent specimens, showing them to be *Byturus*) which were present.

One of the caterpillars sent had spun up except at head end, colour become yellower below. A chrysalis (spun up in web in the bud) was tawny or reddish yellow on as much of the back from the head onwards as was visible. The wings, which were folded beneath it, were yellowish. The abdomen was of a full pink.

A few days later, Mr. Wheeler forwarded me a further supply of buds, with the observation "that the new shoots seemed to be free from attack, but most of the first buds have been destroyed. We have already picked out most of the diseased buds, so that we have had some difficulty in finding any more."

The above observation was satisfactorily completed by a characteristic specimen of the moth *Lampronia rubiella* developing from a chrysalis in one of the Raspberry buds sent me from Newnham Court. This I first observed to have emerged on June 1st.

The following are the main characteristics of the appearance of the moth; see also figure at p. 90. The expanse of the wings is a little under half an inch. The head ochry grey with yellowish face; horns dull brown. The forewings shiny, with a brown ground, marked with yellow dots and various yellow spots; of these spots two are very noticeable on the hinder or inner margin, and there are four smaller spots on the costa or fore edge. The fringes are brown, with tips white at the end of the wing. The hinder wings brown, with paler fringes.*

The observations contributed this year give a very fairly complete history of the life of the insect, from the first appearance of the young red caterpillars from their winter shelters to the development of the moth. We find them straying about the Raspberry canes whilst as yet the buds are hardly sufficiently grown to receive them, and presently in full tide of mischief migrating from one bud to another, and as the plant growth goes on we have notes of the young shoot failing beneath the presence of the pest within, almost as if they had been frost-bitten. From specimens sent, I had opportunity of noting the colours of the chrysalis spun up in the bud, which I am not aware of having been recorded before, and also reared the moth.

Here we have the history of most of the attack agreeing in most parts with what we had general observation about before, but the intermediate history (that is, where the moth which is known to be common in June lays her eggs, and where the young caterpillars feed before they hide up for the winter) was, I believe, unknown until observed and recorded last year by the well-known entomologist, Dr. T. A. Chapman, of Hereford.

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* For description in precise scientific wording, with synonyms of the species, see Stainton's 'Tineina,' p. 39.

Observations were given, very many years ago, on (I believe) the authority of Bjerkander, that the moths laid their eggs on the Raspberry-stems, and they were stated to feed on the foliage. In Stainton's 'Tineina' (p. 89), the author just shortly states, "The larva feeds under the fruit when young, hybernates without feeding, and in the spring bores down the stems of the young shoots." But the following extracts from Dr. Chapman's published account of his own observations, appear to me conclusive as to the method and place of egglaying of the moth.

Dr. Chapman wrote * :—"The egg of *L. rubiella* is laid when the Raspberry is in flower; I have twice seen the process take place, and on one occasion besides saw it fail. The moth selects a fully open flower," and here Dr. Chapman gives a minutely detailed account of the operation of egglaying, culminating in the egg being inserted in the "receptacle" of the flower, so as to lie about its own width beneath the surface. In the case of failure mentioned above, the moth had attempted to lay on a not fully opened flower.

Further, quoting Dr. Chapman's words:—"When the Raspberry is ripe, and is removed by human or other agency, the larva of *rubiella* is in the fleshy white receptacle,† but is ready to quit it, and does so immediately. In one such receptacle were two larvæ. So far as I could see, their presence does not interfere with the due development and ripening of the truit."

From further observations, Dr. Chapman found that the larva spins itself a little round, flat, white, silk cocoon not much more than the twelfth of an inch in diameter, and that on its leaving the "receptacle" (which he notes may be in the way mentioned above, or by boring a way out at the base by the footstalk) that it no doubt goes down to the stool of the plant, and passes the winter in such a cocoon as he describes, from which it emerges in the spring.

PREVENTION AND REMEDIES.—One of the most effectual methods of checking recurrence of attack must certainly be that mentioned above, of breaking off the infested buds, or little shoots, and destroying them. At the visit of the Evesham Fruit Experimental Committee to the Toddington Fruit Grounds, on the 12th of May, a large basket was shown filled with Raspberry shoots infested by the caterpillar of *Lampronia rubiella*, as a sample of several other basketfuls which had been collected in the previous part of the day. This method of clearing the pest, however, requires some care in carrying out, for, as shown above, the caterpillar by no means necessarily remains in its own bud. Very likely at Toddington some plan would be adopted to keep the caterpillars from straying; but (if nothing else occurred) probably a rough lining of canvas, fixed inside the collecting-baskets, which would allow of a good sprinkling of paraffin oil being given to it, and so prevent escape over the edges, would probably be a good plan. In any case the infested shoots should be burnt, or destroyed in some way as soon as possible, or otherwise, in case the caterpillars are so nearly full grown as for the time of their change to chrysalis to be at hand, almost as plentiful a development of the moth may be expected from the gathered shoots as if they had remained on the bushes.

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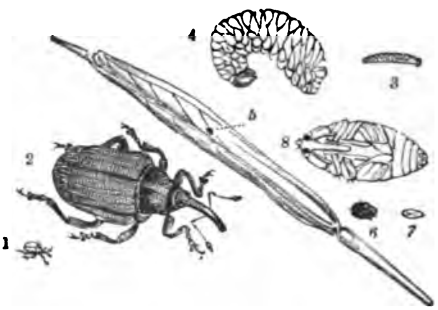
* See paper in number of 'The Entomologist's Magazine' for June, 1891, p. 169, entitled "The oviposition and autumnal larva of *Lampronia rubiella*."

† For figure of "receptacle" of Raspberry fruit, with the berry removed, see sketch of Raspberry at p. 85.

No attempts appear to have been made at present to prevent the attacks of the little red caterpillars when they come out from their small white silky cocoons, or from the sheltering-places where they have passed the winter. But where there is reason to expect bad attack, it might be worth while to try the effect of some preventive dressing thrown round the base of the canes. Such an application as ashes, or dry material sprinkled with paraffin oil, in the proportion of a quart of the oil to a bushel of the dry material has been found to do no harm to the young Hop shoots coming up through it, and would be at least worth trying on a small scale, if not applicable on the broad scale of farm gardening.

TURNIP.

Turnip-seed Weevil. *Ceutorhynchus assimilis*, Payk.
Flower Beetle. *Meligethes æneus*, Fab.



CEUTORHYCHUS ASSIMILIS.

Beetle, maggot and chrysalis, nat. size and magnified; infested Turnip pod.

The following notes refer to two kinds of beetle attack affecting the flowering shoots of Turnips and other plants of the Cabbage tribe, and which by injuring the blossom buds, blossoms, unripe seeds, and in some cases the shoots themselves, materially lessen the amount of the seed crop. These two kinds of beetles are respectively the "Flower Beetle," scientifically the *Meligethes æneus*,* and the "Turnip-seed Weevil," scientifically the *Ceutorhynchus assimilis;* but as the "Seed Weevil," though especially injurious when in maggot state to the young forming seed, feeds when in beetle state partly on the flowers; and the "Flower Beetle," whether in beetle, or in maggot state, so injures the flower, and the fructifying parts, that it lessens amount of seed; and also as both kinds of beetles are often to be found together on the flowering shoots of the Turnips, or other plants which they infest, it has seemed best to notice the two attacks together.

The Turnip-seed Weevil is a small blackish or greyish beetle, not quite the sixth of an inch long including the proboscis. The shade of colour depends very much on whether the specimens are fresh, or rubbed. The beetles are black, with a sprinkling of fine white hairs above, and scales below, which give a greyish tint, and when these are rubbed off, the beetles look black or patchy. The wings are ample, and thus the insect has great powers of dispersing itself around.

The life-history, as given by various writers, is, that after hybernation during the winter, the weevils of the preceding autumn come out again in the following spring, and appear on the flowering shoots of Turnip, Rape, Mustard, or other allied plants. Rape is noted by one Continental observer, especially, as being attacked, the beetles gnawing the buds and flowers, and the maggots feeding on the seed in the pod, so long as it is not ripe. Consequently on this a kind of premature ripening takes place, and the infested pods are stated commonly to open earlier than those which are uninjured. The full-grown maggots under these circumstances fall to the ground. In the experiments noted by John Curtis, they buried themselves two to three inches below the surface, and enclosed themselves in brown oval cocoons formed of earth.

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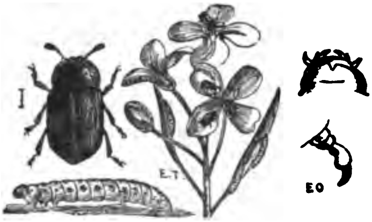
* As mentioned further on, the *Meligethes viridescens* may also be present.

The maggots are of the shape figured at p. 96, fleshy, legless, transversely wrinkled, yellowish white in colour, with pale brown head. The pupa is of a dull ochreous colour, with black eyes. These descriptions give the appearance when much magnified, but without the help of a glass they are much too small for the characteristics to show clearly.

The duration of the pupal state is of three or four weeks in summer; so where circumstances are favourable, and food-plants at hand, there may be two broods during the season, and the weevils which hybernate in the latter part of the year, supply the parents for the first brood of the following season.

The above slight sketch of the history of the Seed Weevil is taken mainly from the works quoted below, as I have never had an opportunity of observing the attack throughout its course personally.*



MELIGETHES ÆNEUS.

Beetle and maggot, magnified, and infested flower, after Dr. Taschenberg; jaws and antennæ of maggot, much magnified.—ED.

The following notes on the life-history of the "Flower Beetle" are taken almost entirely from my own observations, extending over several weeks in the summer of 1872. †

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* 'Farm Insects,' by John Curtis, p. 105; 'Praktische Insekten-Kunde,' by Dr. E. L. Taschenberg, Pt. ii., p. 166; and 'Tierische Schadlinge und Nutzlinge,' by Dr. J. Ritzema Bos, p. 317.

† These observations were undertaken at the request of the late Andrew Murray, F.L.S., Curator of the South Kensington Collection of Economic Entomology, relatively to some (possible) variations in characteristics of broods of different

My observations began on the 22nd of May, and were carried on at Sedbury Park in West Gloucestershire, my then home. The attacks were watched on Turnip, Rape, and Cabbage blossom, but mainly on the two former. The *Meligethes* observed were the *M. æneus*, and the *M. viridescens*. Presumably the *æneus* was present far more numerously than the *viridescens;* but in the out-of-doors part of my observations, where hundreds of the beetles passed under review, it was impossible to distinguish between these very similarly coloured and sized beetles by examination of structure of the shank of the fore-leg; therefore for security I describe them now (as in my original paper) as "Green Meligethes," though probably *almost all æneus.*

This species is one-twelfth of an inch, or rather more, in length, of the shape figured at p. 97; variable in colour, brassy green, or violet, or sometimes with a bluish tinge; legs red with pitchy thighs. The *M. viridescens* is about the same shape and size, the colour green or bluish green, or blue-black above, with reddish legs. The only absolutely sure point of distinction appears to be that the anterior tibiæ (*i. e.*, shank of the fore-legs) are slightly serrated along the outside in *æneus*, and are not so in *viridescens.*

About the 6th of June, I found the "Green Meligethes" or "Flower Beetles" in great numbers on flowers of the Cabbage kind, then apparently feeding only on the pollen, which they collected in any way that might chance,—either from the anthers or from where it had fallen on the flower, or on each other's backs, or by drawing their shanks with pollen attached through their jaws. At this date I found eggs were formed within the beetles, and shortly after both eggs and maggots were noticeable.

The eggs I observed were long, cylindrical, and blunt at each end, and so transparent that the development of the maggot might be watched within from the day after laying. Hatching took place in four or five days.* The maggots, in the early stage, were whitish, the dark head furnished with a pair of sharply pointed, much-curved jaws. The first three segments each bore a pair of claw-feet, and the proleg at the caudal extremity was made great use of in progression.

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species. These necessitated careful notice of the insect, and record of habits from egg-laying up to perfect development, and the main points of the observation are given in two papers (with figures of larval development within the egg, also by myself) published in the 'Entomologist's Monthly Magazine,' numbers for July and August, 1874.

* A clear and full account of the life-history of the *Meligethes æneus* is given by Dr. Taschenberg in his 'Praktische Insekten-Kunde, pt. ii, pp. 12—14; in this he names eight to fourteen days as the time of hatching. My own observations were taken in a sunny garden with warm exposures, or from specimens brought under artificial circumstances which might accelerate development.

The head was purple or dark, with a shield-shaped marking pointing towards the top, and the segments immediately behind the head, with two patches reaching nearly to the middle of the back; the succeeding segments with one spot on each side, the three preceding the tail with an additional spot in the centre, and the last segment with the three spots confluent; each segment was furnished with a bristle on each side, excepting that next the head, which was furnished with two or more. When full grown the larva was whitish.

The method of life, as I observed it on various plants of the Cabbage kind, was as follows:—About the 6th of June *Meligethes* were to be found in great numbers in the blossoms, apparently feeding entirely on the pollen (probably they had been about for some weeks previously); shortly afterwards eggs and maggots were noticeable. The eggs were laid within the unopened buds, and the maggots were to be found in profusion by the 17th of June in the buds and partially opened flowers, which were distinguishable by their stunted and shrivelled appearance. The maggots appeared to prefer feeding at the base of the blossom; presently they spread from the flowers, and might be found in parties of a dozen or two at the base of the stalks of the topmost flowers; others distributed themselves variously, but chiefly on the seed-pods, where the gnawing motion of their brown jaws might be clearly seen against the light colour of the vegetation. Some of these maggots, which I had under observation, left the sprays on the 17th of June (by falling down), and then buried themselves as quickly as they could. About ten days later, I found the chrysalis already formed in an earthen cell, about three and a half inches below the surface of the ground. Probably in natural circumstances, and the hard ground of a field, the maggots would not go so deep.

I had not opportunity of observing the period which elapsed before development of the beetles, and therefore complete the history from the observations of Dr. Taschenberg, referred to above. The earlier date of pupation is probably owing to the differences of Continental climate, and it will also be noticed that he mentions the change to chrysalis taking place in a lightly-spun web, which I did not notice myself, but might possibly have overlooked within the earth cell. Dr. Taschenberg notes:—"At the beginning of June they (the larvæ) are mostly fully grown; they let themselves fall to the ground, and in ten days turn, a little below the surface, within a lightly-spun web to the pupal state, from which the beetles make their appearance in from twelve to fourteen days. These may be found throughout the summer on all the neighbouring blossoms so long as weather permits, and then creep down into the ground for the winter." *

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* 'Praktische Inseken-Kunde,' by Dr. E. L. Taschenberg, pt. ii., p. 11.

These beetles are also one of the regular pests of Mustard when it is "knotting" up for flower. In 1886, when circulars were issued by the Royal Agricultural Society requesting information as to the habits of the "Mustard Beetle" (*Phædon betulæ*), and means of prevention of its ravages,* specimens of the *Meligethes æneus* were sent me taken from Mustard at various localities, at dates from June 10th to July 27th; and I had the opportunity of myself examining the attack in the fields at Coldham Hall, and Stagsholt, near Wisbech, during July. It appeared then to be nearly or wholly impossible to do anything by way of remedy to the attack on the growing Mustard. Whether now, by means of the Strawsonizer, anything could be done to clear the attack remains to be seen; but the following detailed observations, with which I was favoured by Mr. John Moss, of Feering, Kelvedon, Essex, and by Mr. Geo. Malden, of Cardington, Beds, show that in the case of the "Flower," and also of the "Seed" beetle attack to Turnips being grown for seed, great benefit may be derived by cutting back the flowering shoots so as to prevent the great swarms of the beetles, which first appear, making good their position, and thus give rise to the legions of maggots which, in their various ways, ruin the hopes of the seed crop. These notes also give some very useful observations on the habits of the insects, and notably, first of all, the vast numbers in which they appeared a little before the 18th of May.

The first communication on the above subject was sent me on the 18th of May from Feering, Kelvedon, Essex, by Mr. John Moss, accompanied by specimens of the small dark greenish Flower Beetle, the *Meligethes æneus*, and the *Ceutorhynchus assimilis*, sometimes known as the Turnip-seed Weevil, which is easily distinguishable from the other kind by its ashy grey colour, and its long proboscis. Mr. Moss wrote as follows:—

"You will find enclosed a quantity of small beetles, clouds of which have arrived during the last week with the dry east wind we have had; the Turnip and Swede seed especially are simply swarming with them. The beetles crowd into the blossoms, and I believe lay eggs, which develop into tiny maggots in the seed pod in June, and cause what are generally called "bladdered" pods; these pods fly open about a fortnight before the good seed is ready to cut, and of course the seed from these pods (which is generally thin and blighted seed) is lost. I estimate that frequently the loss from these tiny maggots is £5 per acre.

"We are seed growers, and you will readily understand that in farming about a thousand acres there is often serious loss from various pests. If you are able to suggest any remedy for this present pest I shall be very glad. I have been using the arsenical solution you recommend, and also paraffin with the Strawsonizer; but as the beetles do not appear to be *feeding* it does not kill them, and they *fly* to other crops, and in a few days are as numerous as ever on the crop treated."

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* See 'Journal of Royal Agricultural Society,' vol. xxiii., p. 273; also my own '10th Annual Report on Injurious Insects.'

Removal of tops and early blooms from the Turnips and results.—On the 18th of May, Mr. Moss wrote further:—"The remedy I have been trying the last few days has been to have women pick the tops and early blooms of the Turnip and Swede, putting them, with the beetles, into bags, which, when full, are carefully tied and the contents buried or burnt. By this means a great number will certainly be destroyed, and as the attack appears to be an early one I hope that, as I have put nitrate of soda on the crop, the later blooms will branch out and fill up, and I trust be free from the beetles. This rain will greatly assist the lower branches to grow." As the beetles chiefly attacked the top and early blossoms, Mr. Moss hoped for good results.

On the 17th of July, Mr. Moss wrote:—"I think a great deal of good was done by securing the beetles by plucking off the early blossoms containing them, and having these destroyed; but how much was due to this or to the heavy rain and artificial manure I am unable to say, but that which looked almost worthless (and would have been so without help) is now a splendid crop. There are, however, a quantity of bladdered or maggoty pods, for if there was not a second attack of the beetles the attack was very long-continued." And to this Mr. Moss added some observations drawing attention to this removal of the early blossom, and causing the plants to branch out afresh, necessarily causing the crop to be later.

On the 3rd of August, Mr. Moss favoured me with a report *regarding the success of the treatment as shown when the crop was cut,* together with some notes as to the period in the beetle attack at which it seemed most desirable to cut off the shoots.

Mr. Moss wrote to me:—"I am now in a position to speak definitely as to result of the method I adopted to counteract the attack of beetle on the Turnip seed. The men are now cutting the crop, and I am happy to be able to report that it is a very good one, quite equal to what I expected before any attack of the beetles was observable. I think I told you that when on bloom the field (of twelve acres) had quite a dirty sooty appearance instead of being bright yellow, and the crop looked worthless; but by securing and destroying the beetles and damaged blossoms, which did not cost more than 5s. per acre, and heavy dressing of manure, which fortunately was followed by heavy rain, a new growth was encouraged and a heavy crop secured, which comes in about three weeks later than might otherwise have been the case.

"I would recommend that there should be no hurry in adopting this remedy, especially if the attack is a serious one. I think it would be better to be a few days late, and so secure, if possible, nearly all the beetles, rather than commence too soon and perhaps have a second edition on the new blossoms. This remedy appears to be a *certain* one as far as destruction of beetles is concerned; the one other important thing is to try and arrange for it to be done just before rain."

On the 14th of May, Mr. Geo. Malden, of Cardington, Beds, forwarded to me some specimens of Swede-heads, which he noted as being infested with two kinds of insects, which proved on examination (as well as those previously described) to be specimens of the Turnip-seed Weevil, or *Ceutorhynchus assimilis*, and the Turnip Flower Beetle, or *Meligethes æneus*, with possibly some specimens also of another species of *Meligethes*.

Mr. Malden wrote accompanying:—"You will remember that last July I had some correspondence with you in respect of the maggot in the Swede seed-pods, by which an immense amount of harm was caused to the seed crop, and that I forwarded some pods containing maggot for your observation. The damage done then was caused by one or both of these varieties I believe, as every head of seed is just now the feeding ground of one or more of these flies, which are in a most active state, and it is at this period that they are probably doing even more harm than they appear to (bad as that is), by laying eggs near the ovary of the Swede flower, and which becoming enclosed in the seed-pods hatches out, and in the form of the maggot destroys all the seed.

"Undoubtedly, from the severe character of this year's visitation, the whole of the seed (and the crop otherwise has up to now looked extraordinarily well) would be destroyed were the crop in full bloom; and to save as much as we can we have been topping all the shoots, in order to throw back the flowering period for another ten days or so, hoping by that time the fly will have departed or assumed a less injurious form.

"You will observe that all the earlier blooms are already more or less destroyed, and they are very busy on the latter; they eat their way to the heart long before the bloom opens, and one variety appears to me to be quite as bad as the other."

On the 18th of June, Mr. Malden favoured me with the following communication, mentioning that he would have written sooner regarding the Turnip-blossom Beetle and Weevil, but waited to see what course these destructive little pests would pursue in the face of the cold rains and winds, and even severe night frosts of the latter half of May.

Mr. Malden observed:—"Though their number seemed greatly decreased, there still remained sufficient to do great damage, to what extent will not be known till the seed ripens.

"They appear to a great extent to have concentrated themselves on an eight-acre field of Swedes, a variety whose bulbs are said to analyse out exceptionally rich in sugar, and doubtless the stems are also sweeter than of most other varieties. The Tankard Turnip-seed, and some stronger Swede-seed, are almost entirely free from these ravages.

"As the Swede is not yet in full bloom, owing to it having been retarded by topping, we hope the insects will before then have assumed a less destructive stage of their life-history, and that the later blooms may escape; very few of the earlier blooms have set at all, and probably the few that have set will burst later on.

"Probably a dresssing such as you describe would be highly beneficial; but of course until such a remedy is tried and proved, there is a danger in experimenting on a large scale; and there is an awkwardness in trying on a small scale, as, as soon as the bitter flavour was washed off the plot dressed, all the insects in the immediate neighbourhood, or on other parts of the field, would be ready to return, and the value of the experiment could not be accurately gauged."

On the 21st of July, Mr. Malden added the following further observations regarding a form of sprayer which he considered adapted for service, and also some amount of estimate of loss:—"'L'Eclair' sprayer,* used by Mr. Riley for the potatoes, appears admirably adapted for use in the Swede-seed crops against fly attacks, and we should certainly use it next year if they attack us in such force as this season, if you then recommend any liquid for spraying; if you do not recommend any liquid dressing, we should broadcast the 'Fisher Hobb's' mixture you advised. The Swede-seed is now ripening, and will be fit for cutting next week. The piece origiually the best, but by far the worst attacked, will not yield above eight bushels per acre; another piece very slightly attacked should yield twenty-five bushels.

"The last blooms on the stems went off about a fortnight ago, and to the last the fly of both the Seed Weevil and Beetle were present, though in considerably reduced numbers, and by that time the proportionately few pods that had set, though attacked, were blistered by the maggot that had hatched inside."

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* This form of sprayer, often known with us as the "knapsack" sprayer without any other special name, has been very generally approved of during the past, as being easily portable on a man's back; it can be used where no wheeled machine could be introduced. For price, address of importers, &c., see p. 76.

To the above observations, Mr. Malden added the important remark, in confirmation of serviceableness of the treatment mentioned, namely, that " our neighbours, who topped the seed last year when we left ours alone, I know had considerably larger yield, and much less fly."

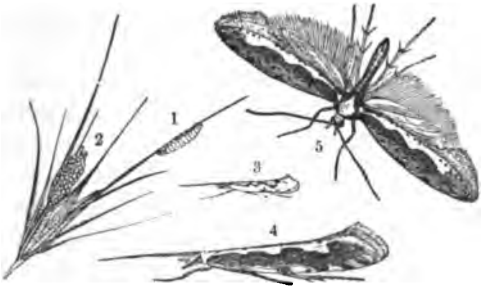
To the above observations, Mr. Malden kindly added the following, at my request, regarding effects of topping:—

Dec. 19th.—"*In connection with topping Swede-seed*, it is a very general practice among growers, who expect thereby to obtain a large yield of seed, as it throws the crop back quite a fortnight in maturing, and thus gives the rootlets an increased time for action, and many more branches are thrown out, and the whole crop is much thickened on the ground. Independently of this, however, it is much to be recommended as a possible means of thwarting the attacks of fly, where the attack has set in early on an untopped field of seed, as thereby the flowering period is delayed for two or three weeks, and by that time the attack from some cause or other may have passed by, though this is not invariably the case. For instance, in 1890, having a very large acreage of Peas that would employ much hand labour about the time we should, in the ordinary course, be rolling topped Swede-seed, we decided to leave the crops alone, so that the harvesting of that crop should be finished before the time for hooking Peas. In that we were successful, but at the expense of the yield of the Swede-seed, for we had a considerable quantity of fly, whilst our neighbours who topped their seed almost entirely escaped; and where our crops yielded from ten to eighteen bushels, they obtained twenty to twenty-three bushels. But in 1891 topping was useless, as the fly remained from the earliest to the latest period of flowering.

"N.B.—The attack of fly was extraordinarily severe this year. One field we grew, estimated by competent observers to yield thirty bushels per acre, finally came out at four bushels. A neighbour's crop was looking exceptionally well at the early blooming period, in fact no better piece was ever seen, and the yield was put at thirty-five to forty bushels: this came out at fifteen bushels. Two other fields belonging to us were estimated at twenty-five and thirty, respectively yielded ten and seventeen. A like result was experienced by all growers in this district, the Turnips being attacked almost as severely as the Swedes."—(G. M.)

From various notes or suggestions given above, it appears very possible that by means of some of the different implements for distribution of insecticides, or by special alterations to adapt them for use on this kind of crop, fluid or powder dressings may be so applied as to be of service. As yet, however, this has to be made out, and the successive date of opening of the blossoms, from the lowest part to the top of the flowering shoots, would throw a difficulty in the way of the use of the fluid applications. It will be noted (p. 104) that retarding date of flowering, and also the alteration in growth caused by topping back shoots, are considered by growers to be beneficial; and this seems really to be the only practicable method recorded of saving the seed on the scale of the great infestations almost sure to coincide with great breadths of growth of food-plant.

Diamond-back Moth. *Plutella cruciferarum*, Zeller.



PLUTELLA CRUCIFERARUM.
1, caterpillar; 2, eggs; 3, Diamond-back Moth (all natural size); 4, 5, Diamond-back Moth, at rest and flying (magnified).

The most remarkable crop attack of the past season has been that of the caterpillars of the Diamond-back Moth. These were first reported to me at the beginning of July as then causing serious damage at a locality on the Yorkshire coast; and about a fortnight later, that is, on the 17th and on the 20th of the same month, the first observations of severe injury in Scotland were reported respectively from localities near the coast in Forfar and in Fife. After this, reports and enquiries, with specimens accompanying, followed each other in rapid succession, until the presence of the caterpillar pest, and its ravages on Turnip and Swede leafage, was proved to be established more or less in every one of the counties of our eastern seaboard, from Dover in Kent up to Aberdeenshire in Scotland, with one observation of presence at the almost extreme westerly locality of Fishguard, Pembrokeshire, South Wales. Other observations of attack followed during the earlier weeks of August, until the area of recorded attack was extended to various other scattered localities in England (in almost all cases in seaboard counties), and to some further localities on the West of Scotland, mainly the Isles of Islay and Jura; and on the 14th of August the appearance of the caterpillars was announced as having been observed in Ireland, mainly along the eastern coast.

During the course of the devastation, I was requested by Mr. Ernest Clarke, Secretary of the Royal Agricultural Society of England, to prepare a paper on the subject for publication in the next part of the Journal of the Society, and I beg to acknowledge, with thanks, that much of the information given in the following report is republished, by kind permission of the Council of the Royal Agricultural Society of England, from the above paper prepared by myself, for which see pp. 596—630 of pt. iii., vol. 2nd of the third series of the Journal of the Society.

Whilst the attack was still in progress, or its first effects still very noticeable, our great object was—by collation of the information contributed by observers—to make out as soon as possible how far this trouble might be influenced by any practicable treatment, and especially whether any remedies could at once be brought to bear; and therefore, for convenience of immediate reference, I divided and classified the information, given in reply to my circular of enquiry, under various headings. Now, however, we appear to have gained a very fair knowledge of the attack in all its bearings; and therefore, in re-arranging the reports placed in my hands once again for publication, I give each observer's notes together. Thus (where the returns are full) we have (with locality and date) an account of the first outbreak, and general estimate of mischief then going forward; 2ndly, special observations in reply to enquiries in circular; and 3rdly (in some cases), reports of extent of loss estimated from total destruction of crop, or from deficient bulbing of Turnips and Swedes, consequently on retarded growth from loss of leafage by caterpillar ravage, bringing some of the observations up to the latter part of December. Thus the effect of local soil, and treatment and local weather, and geographical position, can be traced and collated in their bearing on ravage, or escape from ravage, of the caterpillars.

In the following paper I have given, *firstly*, an account of the Diamond-back Moth, the *Plutella cruciferarum*, in its different stages; *secondly*, the reports contributed by observers of the attack of 1891, these being arranged, so far as is possible, under the heads of the respective counties reported from in England and Scotland, beginning in each case with the first observations of outbreak (the few Irish returns being appended); and *thirdly*, the notes bearing on observation of appearance of Diamond-back Moths at various places on the coast shortly before attack of the caterpillars.

To these returns a summary is added, in which I have endeavoured to work out some of the chief points of information contributed into a form for practical use; but for those who are inclined to work out the details of several of the longer returns, there is a great deal of useful practical suggestion well worth study; and I beg to offer my best thanks to all my contributors for the prompt care and courtesy with which they were good enough to reply to my requests for information.

LIFE-HISTORY AND HABITS OF THE DIAMOND-BACK MOTH, *Plutella cruciferarum* (of Zeller).

This moth is common and abundant in this country in many places during the summer, but it is rarely that bad attacks of its caterpillars to the Turnip crops have been recorded. One of the first records of really serious ravage appears to be that given by John Curtis, as occurring near Petersfield, Hants, in August, 1837.* The next notice of widespread presence and severe damage does not appear to have taken place until 1851, when it was recorded on the high authority respectively of Prof. J. O. Westwood, and of Mr. Stainton; and since then, until the past summer of 1891, I am not aware of any *large* area being infested in this country by this Turnip-leaf pest.

Local attacks, of which observations were sent me, occurred in 1883 and 1884; † these were for the most part at widely separated localities,—as near Harwich, Essex; King's Lynn, Norfolk; Inverurie, Aberdeenshire, and (in both years) at a few places in Yorkshire; and it was from the benefit that appeared to be derived from the use of the scufflers, and quite certainly from application of nitrate of soda in some of these cases of infestation, that I felt justified in suggesting these measures on the outbreak of the threatened caterpillar devastation of the past season.‡

DIAMOND-BACK MOTH. — *The size of these moths* is only about, or rather under, two-thirds of an inch in the spread of the wings, and to ordinary observation when at rest they appear as brownish-grey moths, about the size of furniture moths, but long and narrow in shape. When at rest, and the upper wings laid along the back, with the edges meeting, the pale patterns along these edges form diamond-shaped marks, whence the English name "Diamond-back Moth"; if seen sideways, the curved-up extremity of the wings, as shown at 3 and 4 in the figure on page 105, is very striking.

On minute examination it will be found that the front wings are long and narrow; greyish brown, darker towards the centre, but marked with some small brown spots in front; a rather broad whitish or ochreous-grey band runs along the hinder margin, with three rounded projections on its front edge; this band is usually spotted with very small dark points, and in some specimens it is considerably obscured by the ground colour on the hinder margin, leaving the three projecting parts alone conspicuous. The hind wings are narrow and pointed at the apex, have a long fringe, and are of a pale ashy grey colour. The body and legs are brownish grey; the head and thorax grey or ochreous grey; antennæ white, with some brown or fuscous rings.

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* 'Journal of Royal Agricultural Society,' vol. iii. (first series), p. 71.

† See my 'Report on Injurious Insects' for 1883, p. 72; and for 1884, p. 81.

‡ I have not enumerated occasions where this attack has been mentioned, as matter of reminiscence, as having occurred; for it is no easy matter to discriminate from memory alone between attacks of various kinds of green caterpillars which work by gnawing Turnip leaves.

The moths lay their eggs for the most part on the under side of the leafage of their food plants, and we see plainly that this is the usual ravaging ground of the caterpillars; still, they may be present sometimes on other parts of the plants.

The caterpillars, when full grown, are about half an inch long, and peculiar in shape, as they taper slightly towards each extremity; this is a marked characteristic. The colour is usually a delicate green or apple-green, but this is variable; in younger state the larva is often yellowish or greyish, with black head.

When near full growth the head is usually grey or yellowish, marked with small black dots, and the next ring is remarkable for the *absence* of the two dark patches often found in small caterpillars of allied kinds, and instead has a number of very minute black specks. The rest of the segments have a few black dots, each bearing a bristle, but these cannot be made out without the help of a magnifying glass. Each of the first three segments bears a pair of claw-feet, and there are also four pairs of sucker-feet beneath the body, and another pair (which are very noticeable from being set out somewhat obliquely) at the end of the tail extremity. When alarmed, the caterpillar lets itself down by a thread, and swings in the air till it thinks fit to return by the thread to its previous locality.

When full fed, which may be in about four weeks, or possibly less, the caterpillars spin their cocoons for the most part on the under surface of the leafage of their food plants, or on stems, or amongst seeds, &c., in fact in any convenient place on or near their food plant. These cocoons are somewhat variable in appearance; sometimes they are a mere open net-work of white threads, sometimes thicker and of a somewhat boat-shaped form. In the former case the colouring of the chrysalis can be distinctly seen through the net; the characteristic colouring, when mature, is whitish with some black streaks. This was very noticeable in some chrysalids sent me by Mr. Moss, from near Kelvedon, Essex, from which Diamond-back Moths soon after came out. In the early part of their formation the chrysalids may be green or brownish; there appears to be a good deal of variety in this matter, so far as I can judge from the many specimens which passed through my hands during the past season.

The time spent in chrysalis state may vary (as given by various writers); it may occupy from rather over one to about three weeks, but there may certainly be two broods during summer or autumn, and the chrysalids from the last brood of the year remain in this state through the winter.

The food-plants of the Diamond-back caterpillars are, by preference, Turnip, Cabbage, and other cruciferous * plants, including notably what we know in England as "Charlock" (*Sinapis arvensis*, L.), in Scotland as "Runches" or "Skellocks." It also attacks, amongst other weeds, "Jack-by-the-hedge" (*Sisymbrium alliaria*, Scop.), a common hedge- or ditch-side plant of early foliage; also the Hedge Mustard or Flaxweed (*Sisymbrium sophia*, L.).

The insect is widely distributed, and is one of the well-known crop attackers on the Continent of Europe, a fact which probably bears very largely on the sudden appearance of the caterpillars amongst the Turnip crops on our eastern coasts. Notes of the vast flocks of the moths noticed, a few weeks before the first outbursts of attack at various localities on the coasts, with coincident observations (which will be found in the following pages) from entomologists lighthouse keepers and fishermen, besides agricultural observers, appear to me to leave no opening for doubt that the attack of the past season was wind-borne to our shores, and that, the crops being just in a condition for attack, the results were what we know only too well.

PARTICULARS OF DIAMOND-BACK MOTH ATTACK IN 1891.

On the 8th of August, in compliance with the request of Mr. Clarke (Secretary of the Royal Agricultural Society) that I would prepare a paper on the Diamond-back attack, embodying such amount of information as might be placed in my hands, I arranged the following short circular, and forwarded it to my correspondents requesting their assistance by replies to any of the points specified:—

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* The specific scientific name appended to that of *Plutella* (namely *cruciferarum*) is a very appropriate one, as it well describes the habits of the caterpillar in mainly feeding on *cruciferous* plants, namely those of the Cabbage kind. The word *Xylostella* appended to *Cerostoma*, by which synonym this moth was formerly known, refers to the habit it was, in early days of observation, supposed to have of feeding on the *Lonicera Xylosteum*, L., the upright or two-flowered honeysuckle, a shrub to be found in thickets, and more especially in Sussex.

Here, however, it seems to me that there may have been some confusion of species. As the case stands at the present day, the *Cerostoma Xylostella* of Stainton's 'Tineina,' p. 70, is distinguishable by several clear characteristics from *Plutella cruciferarum*.

The moth of *C. Xylostella*, besides being rather broadly yellowish-white along the hinder margin of the upper wings, "has an extremely narrow oblique white streak running half *across* the wing beyond the middle." Also, the caterpillars are green, *with a broad red stripe on the back*, and are tapering to the *head* end, and make a *firm* cocoon.

During my own investigations, I found a very few green caterpillars striped with brown or reddish brown, which may possibly have been of this kind.

"1.—*Any estimate of amount* of loss, whether in acreage, mileage, or money loss, on crop.

"2.—*Any measures found to answer in lessening amount of ravage or loss from its effects;* as, for instance, effect of fertilizers, as nitrate of soda, superphosphate, soot, lime, &c., given as dressings to push on crop; or any dry or fluid dressings applied to the leaves to clear the grubs, and how applied, as by Strawsonizer, Knapsack Sprayer, &c.; also effects of any mechanical measures, as taking horse-hoes, or scufflers with boughs on them, through the crops; or use of 'sheep driving.'

"3.—Opinion asked as to benefit of heavy rains.

"4.—*Nature of land*—also how cultivated (especially whether autumn cultivated and whether ploughed deeply)—what manure was used, and was salt used.

"5.—*Was weather* observably wet or dry in previous autumn, so as to cause difficulty in cleaning the land, and was any particular weed unusually noticeable.

"6.—Is this caterpillar found to especially *frequent Charlock?*

"7.—*What kind of birds* are especially useful in clearing the caterpillars."

In the following notes I have arranged, in sequence (and with due acknowledgment to the contributors), the observations sent me of first outbreak of ravage of the caterpillars; the replies sent to the inquiries in the above circular; and some amount of information as to direct loss, or estimate of extent of deficiency of crop, which were forwarded later in the year. These observations are given, as far as possible, in the words of the contributors, with date and locality, and name of writer. They are arranged under the main headings of England and Scotland (with some small amount of observation of the presence of the infestation in Ireland); and, so far as is practicable, are further arranged under headings of counties, beginning in each country with the first observation forwarded. In England this was sent from Long Whins, Hunmanby, Yorkshire, a locality near the sea-coast, about eight miles S.S.E. of Scarborough.

ENGLAND.

YORKSHIRE.—*Long Whins, Hunmanby,* July 2nd. From Mr. Robt. W. Smith. — The specimens of caterpillars sent accompanying varied in size from about a quarter to fully grown, and were of various tints, from yellowish to apple-green. The Turnip leaves were much eaten from the under side, so as often to leave mere patches of the upper cuticle of the leaf remaining, and often they were eaten completely through.—Ed.

Mr. Robt. W. Smith wrote:—"Herewith I send you leaves of Turnip, with specimens of caterpillar, which has on some farms in the neighbourhood entirely destroyed the Turnip crop, and is fast destroying it on my own."

Replies to inquiries in circular (see p. 110), August 10th:—

(1). "I have had no root-crop quite destroyed, but the estimated produce per acre of Kohl Rabi has been lessened 75 per cent., Swedes and white Turnips 50 per cent., and yellow Turnips 25 per cent. Loss, £60.

(2). "I tried 5 cwt. of dissolved bones per acre, put on each plant by hand, without effect. Before applying the bones I had tried sulphur and lime (after scuffler with boughs on), fumigation with sulphur, Paris-green mixed with water, and Little's non-poisonous sheep-dip; all likewise without effect.

(3). "I think that heavy rains do good by 'soiling' the under side of the Turnip leaf, and making it rather difficult for the caterpillar to work; also by alarming them, or washing them off.

(4). "Clay-loam. Not autumn cultivated. Ploughed deeply in autumn and twice in the spring. Half of Kohl Rabi was farmyard-manured, but no difference is to be seen between the manured and unmanured parts. Dissolved bones and half-inch bones were drilled with Kohl Rabi and Turnips. No salt was used.

(5). "The first half of the autumn was dry (very), and the latter half was very wet. No particular weed was unusually noticeable.

(6). "No Charlock in neighbourhood.

(7). "I think the Starling. Infested crops have been much frequented by Rooks."—R. W. S.

Spikers Hill, West Ayton, Yorks., July 21st. From Mr. John P. Darrell, for Mr. T. Darrell.—"Enclosed I send you specimens of caterpillars, which are eating up all Turnips and Swedes in this locality. . . . At present the brutes are eating all in front of them."

Lebberston, near Filey, Yorks., July 24th. From Mr. John P. Darrell, with specimens accompanying.—"I find, since I wrote to you the other day, the caterpillars have somewhat abated; we have had some nice showers, and it seems to strengthen the plants."

Replies to inquiries in circular (see p. 110), August 11th:—

(1). "The caterpillar pest is about over in this district, and not before time, as they have completely ruined the Swede crop; there will only be a half-crop. I find Turnips have not suffered nearly as much, and look fairly blooming.

(2). "The method I found to answer best, and the least cost, was using a scuffler with thorn boughs attached in front, and set so as to turn the leaves completely over; by so doing it broke the webs and let the caterpillars down, and the scuffler buried them. I found that to answer better than using quicklime, as some of my neighbours have been doing.

(8). "The heavy rains we had a week ago did an immense amount of good, splashing the soil on to the under side of the leaf, and either drowning or setting them away.

(6 and 7). "I have noticed Charlock, but could never find any caterpillars on; and as for birds, the common House Sparrow has done a lot of good by picking off the grubs."—J. P. D.

Pocklington, Yorks., July 22nd. From Mr. Thomas Brown, with specimens of Turnip and Cauliflower plants, infested by Diamond-back Moth caterpillars, accompanying. — "According to report received, there are scores of acres similarly affected. I am under the impression that the principal cause is the dry weather of the last few days. To-day, here, we have had some nice showers, beneficial in most respects."—T. B.

Great Driffield, Yorks., July 24th. From Mr. G. W. Clark (auctioneer and valuer).—Specimens of caterpillars of Diamond-back Moth received as samples of "the pest that is making havoc of the Turnips."

Replies to inquiries in circular (see p. 110), August 11th:—

(1). "The loss I could not really estimate; in some localities the Turnip seems nearly worthless, in others half a crop, and the best, where attacked, I should consider will only make two-thirds.

(2). "My son, on a farm of Earl Londesborough's, tried nitrate of soda, with better result by far than his neighbours, who used soot, lime, and other manures.

(4). "I travel through the greatest Turnip district in Yorks. weekly, and observe the ravage of the pest very minutely. I find it to vary very much, affecting the plant more on flinty soil on the wolds than chalk; also on low lands, where there are different kinds of soil in one field,—say, strong, gravel, and peat,—affecting the gravel and peat, and leaving Turnips on strong land very little hurt.

(5). "I never saw the land in finer condition for the growth of Turnips; it was all that could be desired.

(7). "I should say any small birds which congregate in large numbers are there for food—the pest really.

Everingham, Yorks., July 25th. From Mr. B. Pippet, Agent for The Lord Herries, with specimens of Diamond-back Moth caterpillars and badly injured Turnip leaves accompanying.—"I enclose you some caterpillars with Turnip leaves. Lord Herries, of Everingham Park, would like to know the species; also the best method of destroying them, as they are ruining whole fields of Turnips about here."

Edenthorpe, Doncaster, Yorks., July 29th. From the Lord Auckland. —"I beg to enclose specimens of a caterpillar which has been devastating the Turnip fields in this neighbourhood. The soil is light sand and gravel.

July 31st. "I visited one of my Turnip fields this morning, which is infested by the moth, and found large numbers of specimens, including larvæ, pupæ, and imagines, the last form being the most numerous.

Aug. 2nd. "In one field near my house, which is sown half with white Turnips and half with Swedes, the former have suffered very slightly in comparison with the latter, but that may be attributed to their having attained a larger and stronger growth. In some places the Swedes appear to be entirely destroyed."

Replies to inquiries in circular (see p. 110), sent on Aug. 15th by Mr. Robert Cook, for Lord Auckland:—

(1). "Loss on Swede-turnip crop about one-third. The White Green Top and Lincolnshire Red Turnips have not been affected by the moth.

(2). "The best mixture we used was 10 cwt. soot, 8 cwt. nitrate of soda, with 1 cwt. sulphate of ammonia, mixed well and sown broadcast by hand whilst the *dew* was on the leaves; 1 cwt. per acre. We also used scufflers with boughs on them through the crops; also we tried quicklime, gas-lime, soot in equal parts, 1 cwt. per acre, with 8 lbs. yellow flowers of sulphur added per acre; but the first mixture proved best in checking the spread of moth.

(3). "The heavy rains have been very beneficial, especially where the nitrate of soda mixture was used.

(4). "Land sandy. Autumn cultivated. We clean the land after Wheat, plough deep three times by crossing, then ridge farmyard manure 12 to 14 cart-loads per acre, with no artificial manure, or 6 cart-loads farmyard manure with 3 cwt. dissolved bones per acre, or the same quantity farmyard manure and 4 cwt. concentrated manure per acre.

(5). "The weather was very dry the previous autumn, and the land in this district was especially well cleaned; no particular weed was unusually noticeable.

(6). "No, we cannot find it so; but the Charlock is not abundant in this district.

(7). "The Rook and the Plover.

LINCOLNSHIRE.—*Holbeach Marsh*, July 17th. From Mr. William H. West (with specimens of leaves much injured by the green, somewhat spindle-shaped caterpillars of the Diamond-back Moth. The caterpillars for the most part very nearly full-grown, ED.).—"I am sending you by this post some specimens of a caterpillar or grub which is making terrible havoc with the Swede-turnip in this district, and which has hitherto been unknown to us. It seemed to appear all at once on Monday last, and has attacked all crops alike, whether they had been affected by the ordinary Turnip Fly or not, and is likely to be most disastrous to agriculturists."

On July 20th, Mr. West further noted that the Swede-turnip crop in the district was very generally affected; and also observed:—"I notice several caterpillars on my Turnip leaves (now in cocoons), and am only afraid that with hot weather attack will come out again, and take the late crops of common Turnip and Rape."

On July 29th Mr. West reported:—"Our Turnips on best-farmed lands are outgrowing the caterpillar, although, of course, they have made sad havoc, and they will only be good *half-crops*: but on weak lands, where there is want of steam underneath the plant, they cut a sorry figure, and many have been ploughed up."

Replies to inquiries in circular (see p. 110), August 12th:—

(1). "I consider that 25 per cent. of the Swede crop in this district in acreage is entirely lost or gone, and that 25 per cent. of the whole crop is so injured as to be valueless; consequently our crop is but 50 per cent. of what it should be.*

(2). "I am of opinion that no application of fluid dressings has been of the slightest service. Nitrate of soda, or fertilisers, may have been, and where the land is in the best heart or condition, the loss will be least; continual scuffling, or in any way brushing the land about, has been beneficial by the assistance and encouragement it rendered to birds.

(3). "To the heavy rains and cooler temperature must be attributed the salvation of the crop.

(4). "The soil is loam of an easily workable nature; it is cultivated on the most improved principles, with autumn ploughing, manured in winter with well-made own yard dung deeply ploughed in, the land then well-worked up and mixed in spring, and the best artificial manure we can procure drilled with the seed about the first week in June.

(5). "The autumn and winter were dry; have never known a winter with less water in the ditches. No weed noticeable.

(6). "Charlock is a weed almost unknown here, but I have heard of a piece of land in a neglected state which has some on, and which is entirely stripped by the caterpillars, and they are evidently fond of Brown Mustard.

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* "In supplementing my reply to question 1, I may add that we cannot form any opinion as to the actual money loss on the crop, as this district is almost entirely devoted to *feeding* flocks, and that consequently so much depends upon the rise or fall in the value of stock, which may nevertheless be somewhat affected by the injury to the Swede crop, as to which way we cannot yet tell."

(7). "Starlings have frequented."—W. H. W.

Sunderlandwick, Driffield, Yorks., July 26th. From Mr. Frederick Reynard, with very numerous specimens of caterpillars of Diamond-back Moths, of different sizes up to nearly full growth, and request for particulars.—"About the accompanying specimens of caterpillars I am sending you, they have been troubling me for the last fortnight; they attack the earlier-sown Swede-turnips only; they are now considerably less in numbers than they were a week ago. I have invariably found them on the under side of the leaf."

Replies to inquiries in circular (see p. 110), August 20th:—

(1). "Damage slight; at present impossible to estimate.

(2). "Damage was done and caterpillars had disappeared before it was known what they were; hence no measures were taken to destroy them.

(3). "Rain appeared to stop the ravages when accompanied by wind.

(4). "Clay-loam; previous crop Oats, deep ploughed in autumn shortly after harvest, cross-ploughed end of January, and twice afterwards; 26 per cent. superphosphate only used; no salt or farmyard dung.

(5). "Weather favourable; no particular weed noticed.

(6). "Have never noticed this caterpillar before.

(7). "Cannot say, but should judge that Sparrows, Rooks, and Wood Pigeons are no use."—F. R.

Appleby (*North Lincolnshire*), (*Post-town*) *Doncaster*, July 20th. Correspondent writing under the name of "N. Lincs." (name not given by request) forwarded specimens of caterpillärs of Diamond-back Moth, and of injured leaves. One of the grubs, just over half an inch long, was lying quiet in slight web, as if about to spin up and change to chrysalis. My correspondent noted:—"My Swedes, and many more in this district, are giving way from multitudes of caterpillars on the under side of the leaf."

Replies to inquiries in circular (see p. 110), August 12th:—

(1). "Swedes damaged greatly here; probable loss of 50 per cent. of resulting food; 5 per cent. of Swede area only totally destroyed; white-fleshed varieties not much damaged here (oolite), but much so on the wolds (chalk).

(2). "In my case nitrate of soda has given vigour to the plant, thus doing good. Friends report boughs on scufflers advantageous.

(3). "Heavy rains (1·73 in. and 2 in.) have done immense good, and caterpillars now gone.

(4). "Oolite and on clay; worse on clay. Autumn cultivated, and ploughed 6 in.; 1 cwt. bone meal, 3 cwt. min. phos.

(5). "Clear.

(6). "Charlock not grown here much.

(7). "Starlings in flocks noted feeding."—"N. LINCS."

On the 18th of August, "N. Lincs." further wrote:—"I again report improvement of the Swede-turnips, but a good crop could not be expected from such shattered plants."

The Sycamores, Alford, Lincolnshire, August 9th. From Mr. J. Eardley Mason.—"Diamond-back Moth larva everywhere, but damage very various in amount, and nothing like what is reported from Northumberland. Some fields have escaped altogether."—J. E. M.

Limber, Ulceby, Lincolnshire, July 25th. From Mr. W. Frankish. The following communication refers to ravages of caterpillars, presumably both of the Diamond-back Moth and of the Turnip Sawfly, as specimens of both kinds were sent me, and it would be difficult to say which of the two kinds is the most destructive.

Mr. Frankish observed:—"The caterpillars are now causing destruction to hundreds of acres of our Turnips; these may in some cases survive the attack, but I fear, if even so, the crop must be much below what it ought to come to in weight per acre. I left mine looking well last Monday to go to the show at Brigg; to-day, on my farm of one hundred acres, I could not recognize them as the same fields. So far as the Turnip plants go, they seem to have attacked those just nicely recovered from the singling operation (hoeing). The only thing I see likely to benefit is to keep the scufflers going, and the men hoeing again after them, to destroy and bury the grubs and caterpillars as much as possible."

Replies to inquiries in circular (see p. 110), August 15th:—

(1). "I have looked round my three fields of Turnips, which were more or less attacked by the caterpillars of one description or the other, but I have no doubt by both,* and find they have by no means recovered their lost ground. The Swedes, fortunately only about eleven acres, are almost worthless, and never can be at the best more than one-third of an average crop; and a crop of common Turnips next to them (38 acres) in the same field cannot be more than half a crop, while two other fields of common Turnips (59 acres) will possibly get to be about two-thirds of a full crop; Turnips sown before and after these fields, about 200 acres, have not been attacked, that is to say, to any serious extent.

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* The specimens I sent you from the Brigg show were brought to me there by a neighbour on an adjoining farm, but I have no doubt we all had the two enemies, as the leaves were eaten in different ways,—one almost entirely, except the central stalk, the other leaving all the fibres, like gossamer almost, or coarse network; but it would be impossible for us or any one to separate the damage by different caterpillars.—W. F. (Mr. Frankish well describes the two methods of injury,—the almost total destruction of all the tissues of the leaf by the Sawfly caterpillar, and the damage which, though as bad for all practical purposes, still leaves much of the upper cuticle of the leaf looking, in its transparent perforated state, very much like coarse open muslin or lace.—ED.)

(2). "All the remedy I made use of was to keep going all the horse-hoes and scufflers I had all day long. One of my neighbours tried trailing a sheep net across his Turnip field, and then sowing lime, but I do not think his field has recovered more than mine. He also had a net hanging on his large horse-hoe trailing on the plants before the knives; this acted well, but the pests were about over when he tried this.

(3). "The rains have done good in encouraging the growth of the Turnips, as, had it been excessively dry, many more plants must have died.

(4). "Our land is light wold land on chalk, but the attack was just as bad on both sand and clay. Two fields of mine were autumn cultivated, and one was simply ploughed in the usual way. Kanite was used (but no salt otherwise) with bone manure.

(5). "The weather was particularly dry. My land was cultivated by steam power. No particular weed observed.

(7). "Crows have been all over the fields since May. Many Starlings appeared when we had the caterpillars, and I noticed many small birds in the Turnips, chiefly Linnets."—W. F.

NORFOLK.—*Kings Lynn*, July 21st. From Mr. Edw. A. Atmore.—"Probably you have heard ere this of the ravages of the little moth, *Plutella cruciferarum* (Zeller), in parts of Norfolk, especially in the north and north-west parts of the county near the sea, this year among Turnip crops. . . . On the 18th of this month I was in fields of Turnips near here, and observed these insects (*P. cruciferarum*) in large numbers. They were present in all stages of devolopment—egg, larvæ of various growth, pupæ and imagines, and already the crops have suffered severely from the attack."

On August 1st, Mr. Edw. Atmore further mentioned:—"The recent, and I may say continued, heavy rains have apparently caused a lull in the attack of this pest on the Turnip crops here, for in many fields I have recently examined I could find very few larvæ, although a day or two previously they had been abundant there. Moreover the rains appear to have much stimulated the growth of the plants."

Replies to inquiries in circular (see p. 110), August 11th:—

(1). "Loss from this attack is without doubt very considerable, especially near this coast (north and north-west Norfolk), where both Cabbages and Turnips were attacked. At Thornham, I understand, the Cabbages were attacked first and nearly destroyed on one farm. I am informed that the loss in acreage amongst the Turnips is about one-sixth of the land sown (one-sixth of about eight acres).

(2). "Soot, and also superphosphate, have been used apparently with good effect.

(3). "All the early-sown Turnips attacked by these caterpillars have been undoubtedly much benefited by sudden and heavy rains. In one field I examined at Thornham, in which the attack was bad, scarcely a living caterpillar could be found after two days' heavy rains. They were very abundant *there* previous to the rain. N.B.—The east sides of fields were far more attacked than other parts.

(4). "At Thornham the soil is fairly good, bright and light, with chalk about two feet below the surface. Land ploughed about three inches—difficult to plough deeper there; no manure used.

(5). "Weather decidedly fine and dry last autumn. Lateness of harvest caused difficulty in cleaning the land. Land not particularly weedy at Thornham.

(6). "The caterpillar of *P. cruciferarum certainly* does frequent *Charlock* here, I think, more so than any other weed, although Hedge Mustard (*Sisymbrium officinale*) is much patronised by it, and Shepherd's Purse (*Capsella bursa-pastoris*) is also used as a pabulum by the larva. I found the moth very abundant *recently* on a weedy strip of a field near Lynn in which *Charlock* was undoubtedly the commonest Cruciferous weed, and showed signs of attention from these larvæ.

(7). "Cannot say that I observed any actually at work devouring these larvæ."—E. A. A.

Horsey, Gt. Yarmouth, E. Norfolk, July 15th. From Mr. C. C. Rising.—"I enclose you herewith some Turnip leaves with small green caterpillars; these attack the leaves from the under side, and take off nearly all the crop." The leaves were much injured both through the leaf, and also so as to leave the skin of the upper side of the leaf remaining, thus giving the muslin-like appearance often characteristic of this attack, which is noted, as is also the beneficial action of heavy rain, in a later communication from Mr. Rising, sent on July 21st:—

"Many of the caterpillars were sent, but evidently made their way out. I will send some more, and would have done so to-day, but the rain and thunder storms are so incessant that it is not easy to collect them. They are a small bright green coloured insect, very active, and appear on the under side of the leaf only, and the leaves, where they have been, present the appearance of fine muslin.

"My tenant brought me the leaves sent in a great state of anxiety, but as he told me he has sown superphosphate and ashes, and the plants were or had been growing fast, I advised him to leave them, as the insects seemed to me to adhere so slightly that I thought a heavy rain would clear off most of them; the past rains have done so, and the plants have taken advantage of the rest, and will, I think, come again; the very heavy rain now will, I think, cure it. I had never seen it here before; the action was so rapid that two days seemed enough to do the damage."

Replies to inquiries in circular (see p. 110), August:—

(1). "In early-sown Turnips the loss in yield is about 25 per cent.; in later 15 per cent.

(2). "The insects lying very lightly on the leaves, brush harrowing once lightly would remove them, and then Strawsonizing with paraffin would, I think, be thoroughly effectual; but as the action of the caterpillars is very rapid, careful observation and instant action on their appearance is imperative.

(3). "Heavy rain would have the same effect as both the above and has effectually cleaned them here; the plants are mostly recovering.

(4). "Fine alluvial, deep and lightly ploughed in different parts. Superphosphate and salt used

(5). "Weather average. Land cleaned. No particular weed.

(6). "Charlock and Turnips suffered equally, Mangold not at all, in same fields. Have never known them on Charlock before, and we have *plenty*.

(7). "Fowls of sorts followed the hoers and eagerly ate the caterpillars. No birds specially noticed although looked for; last winter killed great numbers of Blackbirds and Thrushes.

"Finally, if no Strawsonizer available, repeating the brush harrowing would, I think, answer equally."—C. C. H.

Oxnead Hall, Norwich, August 8th. From Mr. R. C. Rising.—"My Turnips are very much injured by the Diamond-back Moth, which is so prevalent this year."

The Manor House, Shropham, Thetford, Norfolk, August 7th. From Mr. Fairman J. Mann.—"Fortunately in this immediate neighbourhood we have not suffered much from the Diamond-back Moth; still I think on my own farm the Swedes, and particularly the Thousand-headed Kale, have been attacked slightly. The latter are full of holes in the heads, but I cannot find any caterpillars. We have lately been deluged with rain, which, I hope, may have destroyed these insects."

August 11th. — "Several of my friends in this county have received most severe injuries from this moth, and they, on Saturday at Norwich, informed me that the caterpillars had disappeared. This my friends attributed to the *enormous fall of rain which has recently fallen in Norfolk.*"

Bale, Dereham, Norfolk, July 24th. From Mr. John Hammond, M.R.C.V.S. (with specimens of caterpillars and cocoons of Diamond-back Moths with Swede leaves much injured by attack).—"The leaves, as you will observe, are partly consumed by a kind of canker-worm or caterpillar. Some hundreds, and possibly thousands, of acres are thus affected in this neighbourhood, and almost every Turnip in a field more or less injured, threatening a serious loss to farmers. My own Turnips are grown in a mixed soil, from farmyard manure and superphosphate."

Norfolk and Suffolk.—One of the most important of the first notes of attack of the Diamond-back infestation which I received was sent me on July 18th, with specimens accompanying, by Mr. E. Clarke, Secretary of the Royal Agricultural Society of England, on the part of Mr. Garrett Taylor, Member of Council of R. A. S. E., of Trowse House, Norwich. Mr. Clarke wrote me that he was informed that the caterpillars were making fearful havoc among the Swedes—in fact, a field of thirty acres had been completely eaten away—and I was urgently requested to telegraph to Mr. Taylor at the earliest moment, as there was as much harm being done as if there was a swarm of locusts.

Whitlingham (*Norfolk*) *and Corton* (*north-east of Suffolk*), July 21st. From Mr. Garrett Taylor, Trowse House, Norwich.—"You are quite right in stating that, when the attack does come, it is apt to sweep the whole crop before it, and this is what it has done at Corton, near Lowestoft. We have given a heavy dressing of paraffin with the Strawsonizer and some of the smaller tenants have scuffled the Swede crops with boughs, and having had some very heavy rains we are hoping that the crop will now outgrow the attack, where it has not been so overwhelming as in some parts of Corton."

On the 30th of July, Mr. Garrett Taylor further wrote:—"I am sorry to find that you substantiate the report that the Diamond-back caterpillar attack has broken out on the west coast as well as on the east. . . . I think the best remedy that has yet been found is a mixture of three-quarters soot and one-quarter lime, and sown on the plants. I am glad, however, to say that the top dressing of nitrate of soda and salt that I have given mine, combined with the heavy rains, has already afforded an impetus to the plants; so much so, I think they are growing away from the little pests and will now do, I hope."

Two days later, that is, on August 1st, Mr. Taylor reported further, "that the heavy rains appear to have killed all the caterpillars, and very few cocoons are left on the leaves, but the roots are slow in recovering. One of our tenants at Corton used a scuffler (filled with boughs) on some Swedes which were not hoed out; this answered very well, and the plants are now growing well."

Replies to inquiries in circular (see p. 110), August 18th:—

(1). "So far as Corton and Whitlingham are concerned, taking the Swede crop (which is the only one injured) at £6 per acre as the maximum value of a full well-grown plant of Swedes in Norfolk and Suffolk at Michaelmas valuation, the greater part of the Corton crop was entirely destroyed, while the remainder (with the exception of one piece, which was sown very early, and appears to have been too forward for the caterpillar to attack) cannot be more than one-third of a full crop under the most favourable circumstances; while the Whitlingham crop being attacked about three weeks later than Corton, the heavy rains coming at the same time washing in a good dressing of nitrate of soda and salt, appears to have at once stopped the ravages of the pest, but not before they had checked the growth of the plants, so that under the most favourable circumstances there cannot be much more than half a crop.

(2). "Nitrate of soda and salt, about four stones per acre of each sown by hand along the drills, were very effective in setting the plants growing; and a scuffler filled with boughs was tried at Corton and answered very well indeed; as also four to six gallons of paraffin per acre applied with the Strawsonizer. We should have tried soot and lime had not the ravages been stopped; should also have walked a flock of lambs backwards and forwards over the plants, which, I believe, would be very beneficial and would act as a scuffler, and would not injure the Turnips.

(3). "Every benefit to be derived from heavy rains—in fact, I much question whether the pest could be entirely destroyed by any artificial means without them.

(4). "The land at Corton is a strongish top soil on yellow clay, and owing to the exceedingly dry weather up to October and frost and snow afterwards, was not ploughed or cultivated until latter end of February or the beginning of March, and then only ploughed fleetly. In some cases the manurings for Swedes were town manure, fish refuse, with a good proportion of salt, mixed up together and put on at the rate of ten loads per acre, while in others 4 cwt. of mineral superphospate and half cwt. of nitrate of soda were applied before the attack. At Whitlingham the surface soil is a good light soil on brick earth, and was cultivated in the autumn, and ploughed a good depth in the spring before putting in the Swedes. Some fields were manured with ten loads of farm manure, and others with 4 cwt. of mineral superphosphate per acre.

(5). "Exceedingly dry up to October, and where stubbles were broken up during harvest or immediately after (before the land got too hard and dry for ploughing), gave farmers a good chance of cleaning the land.

(6). "Have no experience of Charlock.

(7). "Cannot say anything as to what kind of birds are especially useful in clearing away the caterpillars."

ESSEX.—*Feering, Kelvedon*, August 6th. From Mr. J. W. Moss.—Mr. Moss reported first with regard to absence:—"I am happy to say I have not seen anything of the Diamond-back Moth, perhaps because this is not a Turnip-growing district. We grow Turnip-seed largely, but although we farm twelve hundred acres nearly, we have not an acre of Turnip-roots." He then added:—"I noticed to day on some cress . . . a large quantity of chrysalids, some of which I enclose." These proved on examination to be very characteristic specimens of Diamond-back cocoons, which had been spun on the seed-vessels of the cress plants, and from these very perfect specimens of Diamond-back Moths developed shortly afterwards."

I had also a note, at the end of August, from Mr. Champion B. Russell, of Stubbers, Romford, in which he mentioned having found cocoons and caterpillars (which, by his description and comparison with identified specimens, must have been those of Diamond-back Moth) in a field which *had been* badly attacked by caterpillars. Still, so far as reports to myself show, the great body of attack did not run farther south than Lowestoft.—ED.

KENT.—*Littleborne, near Dover*, July 31st. From Mr. Montague Kingsford, with specimens accompanying of caterpillars of Diamond-back Moth (for the most part spun up for passing into chrysalis stage), and also specimens of much injured leafage.—"I have found to-day, in a three-acre piece of Brussels Sprouts, that a caterpillar has ravaged the leaves from underneath, and in some cases has almost destroyed the plant. I have gathered some of the leaves with the caterpillars upon them, and have sent them to you to-night."

Replies to inquiries in circular (see p. 110), August 18th:—

(2). "Brussels Sprouts attacked. A part was syringed with a preparation of soft-soap and paraffin, 5 lbs. of the former and 5 pints of the latter, to 100 gallons of water; result, caterpillars destroyed; remainder of plants, soot scattered on the under side of the leaves; result, same as above.

(3). "It is believed, however, that the heavy rains have been chiefly instrumental in clearing the caterpillars.—M. K., per bailiff.

SOUTH WALES. — *Pembrokeshire. Treathro, Fishguard.* From Mr. W. Reynolds, with specimens of Diamond-back caterpillars accompanying.—"I beg to send you samples of Turnip leaves affected by some caterpillars; some of the worst part sent. The crop was sown early, and is very forward, but the whole of some three acres affected." —W. R.

SALOP.—*Ellerton Grange, Newport*, August 3rd. From Mr. T. H. Ward.—In reference to previous communication regarding caterpillars affecting the Turnips, Mr. Ward forwarded specimens of Diamond-back caterpillars then ravaging the leaves (of which some were gone into cocoon), and also some of the injured leaves. Mr. Ward remarked:—"I now forward you specimens of green caterpillars ravaging the leaves of Turnip, with leaves damaged by them (is this the Diamond-back Moth?). The Wood Pigeons have been very destructive with the leaves of the Swede-turnip this season; I presume it is through this attack of caterpillars."

Replies to inquiries in circular (see p. 110):—

(2). "Where stimulating manure (nitrate of soda) has been applied, Swedes appear to have more vigour after severe attack has passed away; not tried any spraying.

(3). "Heavy showers undoubtedly have done good.

(4). "Friable loam; farmyard manure ploughed under deep in winter, a dressing of 5 cwt. steamed bones, and 1½ cwt. nitrate applied when Turnips were sown; no salt used.

(5). "Remarkably dry winter and spring; no particular weed."—T. H. W.

CHESHIRE.—*Bradwall Reformatory, Sandbach*, August 15th. From Mr. S. Suffield.

Replies to inquiries in circular (see p. 110):—

(1). "Estimate of loss per acre, £10.

(2). "Nitrate of soda at the rate of 2 cwt. per acre as a top dressing, to push forward the growth of plants, is, I believe, very beneficial; it acted well for our Turnips.

(3). "Very heavy thunder showers might shake the leaves, and cause the caterpillars to fall to the ground; but I believe a good strong wind would disturb the plants a great deal more.

(4). "Nature of land heavy, strong soil; spade and fork culture nearly throughout August in the autumn to the depth of 8 or 9 in.; gave part a light dressing and part a heavier dressing of gas-lime (the heavy dressing would be at the rate of 3 tons per acre, and the light one 1½ tons per acre) about the 19th of December; allowed it to remain on the top until March; and where the heavier dressing was put *very little* destruction was done by the caterpillar. Good litter manure was used at the rate of 12 tons per acre, also a specially prepared artificial manure of 5 cwt. per acre; 1 cwt. of salt per acre was part of the artificial manure.

(5). "Wet weather in previous autumn; the land free from weeds.

(6, 7). "Cannot say."—S. S.

LANCASHIRE.—*Estate Office, Lytham*, August 10th. From Mr. Thos. Fair.—"I am forwarding to you two small caterpillars" (of Diamond-back Moth, Ed.), "and some Turnip leaves. The crop from which they were taken has been very much damaged, and I shall be glad to know of any remedy or prevention."

Replies to inquiries in circular (see p. 110), August 13th:—

(1). "Three statute acres have been rendered quite useless.

(3). "The leaves up till about ten days ago had been eaten quite bare, but after the heavy rain showers of last week they grew again.

(4). "The land is strong black land, with a subsoil of white ore; it was ploughed in the autumn to a depth of about 9 in.; the field had a light dressing of ordinary farmyard manure, and one acre had 2½ cwt. of dissolved bones. The weather was wet in November, but subsequently very dry.

(7). "A great number of Sea Gulls have frequented the field, and also a few Grey Plovers.

"I have noticed, on the east coast of Yorkshire, that Turnips seem to be similarly affected to a considerable extent."

Oct. 6th. "The field about which I wrote to you in August has, I am glad to say, worked out fairly satisfactorily, though there are patches in it where the crop has been quite destroyed. I attribute its improvement to the heavy rains we had in August, which destroyed the caterpillars."—T. F.

Durham.—*Parklands, Castle Eden*, July 24th. From Mr. Rowland Burdon, with specimens of Diamond-back Moths and caterpillars accompanying.—"I am sending to you to-day a box containing (1), Swede-turnip leaves covered with green caterpillar; (2), smaller box containing four specimens of a moth. I have a field of Swede-turnips close to the sea—some 12 acres—almost every leaf of which is covered with these caterpillars, and in the same state as the enclosed specimens; and, as there are quantities of these small moths flying about, I fancy they are the source of the mischief. The attack only commenced a week ago. We had dry weather till St. Swithin, and every day till yesterday since then has been wet, more or less. The Swedes would be meeting in the rows in a fortnight, but now look as if the whole field would be spoilt. . . . Another field about half a mile off is looking very well. The caterpillars are almost invariably on the low side of the leaf; so that a Strawsonizer, even if I had one, would hardly reach them."

On Oct. 6th, Mr. Burdon further wrote me regarding the then state of the attacked crops:—"As to the attack on my own fields, my bailiff applied soot, pure and simple, and I was very much assisted by quantities of small birds, chiefly Starlings and Finches. I could not at this moment tell that the fields had ever been attacked. The Swedes are distinctly a good crop; if anything the 12 acres that suffered most is the best of the lot. I do notice, however, that my Swedes have been more to leaf than usual. Whether this is due to the weather or the soot, or that Nature has overdone it, so to speak, in recovering from the attack, I cannot say."—R. B.

On application, on the 21st December, to Mr. Rowland Burdon for some further points of information, he favoured me with detailed observations of attack on his farm of Horden Hall (Castle Eden, Co. Durham), drawn up by his farm bailiff, Mr. John Grindley, from which I give below the main points. It will be observed that the attack was markedly noticed, both as to first appearance, and also as to being most injurious on the plants nearest the sea.

Field of 19 acres, of which 16 acres were sown with Swedes on the 8th and 9th of May. A portion of the field badly attacked by Diamond-backs. Soot applied to this portion at the rate of 2 cwt. to the acre on the 7th and 8th of August.

Another field of 24 acres; 14 acres sown with Swedes on the 22nd of May. Attacked severely by Diamond-back. Soot applied August 6th at the rate of 2 cwt. to the acre, sown by hand, one drill at a time, the sower stooping a little, and keeping his hand low at the delivery. The plants at date (August 6th) looking bad; the leaves almost covered by Diamond-backs, perforated; younger shoots withered, sapless, and of a pale brown colour. The remaining portion sown with Aberdeen Yellow Turnip-seeds on 13th to 18th of June, and not affected. After the soot was applied it was not long before the pests appeared to drop from the leaves to the ground, the plants recovering. Three single horse-hoes were put on, doubling the drills as they were done in opposite directions. The observer (Mr. Grindley) especially notes :—"From the close observations and examinations I made, I am thoroughly satisfied that the soot did not kill the Diamond-back, only dislodged it, strengthening and increasing the growth of the plant." He also noted that "this field is situated direct east of the above, and almost adjoining the sea, and was the first where the moth appeared." —J. G.

In the other field reported, three acres were sown with Swedes on the 24th of May, and seven acres with Aberdeen Yellow Turnips on the 10th of June. These were treated with gas-lime, 12 cwt. to the acre, on the 3rd and 4th of August, the plants at this time being perforated, the drill-ends adjoining the sea worst. "The gas-lime did little good to any part; in fact, drill-ends of both kinds of plants adjoining the coast were horse-hoed, redrilled, and sown with Rape. I might also add that the same results followed from a small portion I tried, as an experiment, with quicklime and superphosphate."—J. G.

Enclosing the above (Jan. 6th, 1892), I was favoured by a note from Mr. Burdon, in which he observed :—"I tried nothing, as you see, but soot and gas-lime separately. The former seems to have succeeded very well, and the latter did little or no good. The Swedes were nearly meeting in the drills when the attack *began*, so whether the results would have been as good if the plants had been more weakly, I do not know; but my Turnip crop is decidedly a successful one this year, quite as good as usual. And the only thing that I can trace to the effects of the moth attack is that the Swedes seem to have been more to *neck*, as well as *leaf*, than usual."

Hartlepool, Co. Durham, Dec. 19th. From Mr. John E. Robson, F.E.S.—"You will be interested to know how the fields of Turnips in this neighbourhood that were so seriously attacked by *Plutella cruciferarum* have turned out in the end. With one exception, I have seen all of them; I mean all those that appeared to suffer much. They have all produced a very excellent crop, many of the Turnips being of large size—extra large, and all of very good quality. . . . One of the farmers, Mr. Collingwood, who had, I think, the worst field of the lot, told me yesterday that, though Turnips were a difficult crop to average, he had seldom had better than this year, and that the two fields which suffered most from the caterpillars were quite as good as any others. . . . I had the impression that the result to be expected was late, small Turnips, and they would be hard or stringy, but that has certainly not been realised here."—J. E. R.

NORTHUMBERLAND.—*Waren House, Belford*, July 24th. From Mr. J. Burdon Sanderson, with specimens of Diamond-back Moths and caterpillars accompanying. After alluding to the specimens (and also a Swede leaf) sent, Mr. Burdon Sanderson continued:—"They are taking the Swedes and Turnips in this country wholesale, some fields being almost left as if no Turnips had ever been there. They are also on some Kohl Rabi and Drumhead Cabbages which I have here. Since the caterpillars first appeared we have had heavy rain, but I regret to say it has not checked them in the least."

Replies to inquiries in circular (see p. 110), August 18th:—

(1). "In some cases in the district round Bamborough the loss is the whole crop gone. I can hardly tell yet what loss I have sustained in my Turnips as I hope they are coming round.

(2). "I applied quicklime by hand on a windy day, as the wind was blowing up the drills; the lime got well under the plants and stuck to the leaves, covering the undersides well. This did not kill the caterpillars at all, but, I think, rather prevented their working, and I hope checked them in spinning their webs or cocoons. I top dressed the worst with nitrate of soda, which stimulated their growth, and thus helped them; but what certainly did the most good was scuffling with light branches fastened across the scuffler, and I consider that the best treatment was to keep constantly working among the Turnips, scuffling and running the small plough between the drills.

"I saw paraffin oil applied on another farm with the Strawsonizer, which, I believe, did little or no good. A mixture of arsenic and lime, also applied with the Strawsonizer, apparently killed the caterpillar; but I did not see this done myself, so cannot speak positively about it.

(3). "Rain did not kill or even wash off the caterpillars in my case, but as it kept the plants growing to a certain extent, it did good.

(4). "Fine loam. In one field I had rather a good instance of cultivation, as out of the field (which is about eight acres) two acres were not ploughed till just before sowing Swedes (the field had been Oats); the rest was ploughed in winter. The caterpillar was equally bad on both bits where Swedes were sown, but hardly did any harm to a strip of early-sown yellow Turnips between the two lots of Swedes. Manure used farmyard and fish phosphate. The Oat-stubble was ploughed about eight inches deep, and was twice ploughed again before drilling.

(5). "There was nothing in the weather to prevent cleaning the land, which is singularly free from any weed. We had an extraordinary hot dry month in February, which might be favourable towards hatching moths.

(6). "There certainly is a considerable amount of wild Mustard about our land. I did not notice the caterpillar on it, but cannot say I looked carefully.

(7). "Birds did not come much to our Turnips, but I believe Peewits and Starlings are the most useful."

(Observation). "I may mention that yesterday, in examining some Turnips in a field here* (this, forty miles from the sea, is high up on the moors with hardly any arable land at all), we found the caterpillars at work in a pretty newly-hatched stage, so though they have got here they are much later. They seemed to be strongest on the sea-coast, and though they reached farms well inland, they were not nearly so destructive. When I left Waren on Monday the Swedes were looking much better, and were almost entirely free from caterpillars, so I hope the worst is over."

On the 8th of October Mr. Burdon Sanderson, writing from Waren House, Belford, reported :—" I am glad to say my Swedes have recovered from the attack, and, though a bit later, are a capital crop. I quite expected to have had to plough them out."

On December 23rd, in reply to my inquiries as to what the ultimate result of attack proved to be in its effect on size of roots, Mr.

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* Written from Otterburn Dene, Otterburn, Northumberland.

Burdon Sanderson was good enough to give me the following detailed account:—

"There is no doubt that where Swedes were badly attacked by the Diamond-backs, the roots are considerably smaller than they otherwise would have been, which, I suppose, is caused by the check in growth that they got at the perhaps most critical time, *i.e.*, a week or two after being singled. Some earlier Swedes in the same field have pulled a first-rate crop of bulbs, but owing to their being almost met in the drill when attached, the insects did practically no harm. Some yellow Turnips, also early sown, turned out well, but the later ones are also small in roots.

"As you say in your letter, the leafage in all these cases was first rate, but when we came to pull them they turned out as above. Of course there were some cases in the neighbourhood where even good strong Swede plants were entirely destroyed, and subsequently ploughed out, but this did not happen to any extent, and where it did it was close to the coast. My land here lies close to a large tidal bay which fills when the tide comes in, but we are some two miles or so from the main sea.

"I may mention that the Kohl Rabi and Drumhead Cabbages have not suffered to any great extent, although partially attacked."

Newcastle-on-Tyne, July 24th. From Messrs. Samuel Finney & Co., seed-merchants, with specimens of Diamond-back caterpillars accompanying.—"We beg to enclose you some specimens of a caterpillar which the last few days has almost entirely eaten up the crops of Turnip and Swedes; it has also attacked Cauliflower and Savoy plants; it seems to extend all along the sea-coast to beyond Berwick-on-Tweed, and to go inland about five miles. The first indication was the appearance of small white-winged insects, the size of the house moth. It is painful to see large sturdy Turnip plants riddled like a sieve, wither and die."

The following short records of appearances of the caterpillar in Northumberland are taken from the number of the 'Alnwick Guardian' for Saturday, August 1st, 1891, by kind permission of the Editor (who also was good enough to furnish me with full names of locality). In this, under the heading of "The Turnip Pest," replies are given from many representative agriculturists of the county of Northumberland to inquiries as to, 1stly, whether the correspondent's Turnips were affected by this pest; 2ndly, whether he believed the destruction of Rooks and small birds has been conducive to the spread of the insect; and 3rdly, what he considers the best remedy.

The paper contains much useful information, especially as placing good practical observations on the subject of this attack, *not* being attributable to the absence of birds, before those who lean to a view of trouble being arising from this cause; but I have only copied the short sentences bearing on presence of the attack.

These will, I think, be considered to show the great prevalence on the coast, and the note by Capt. Winchester regarding the clouds of moths being brought by the *easterly winds* from the shore; and being seen on the Farne Islands (when the wind was blowing *towards* the shore) is a valuable confirmation of other observations, all pointing to the pests being windborne, and spreading westward on the land.*

The notes are arranged in two series of localities; the first running from Beal southward along or near the coast, the other more inland.

Mr. A. M. Hardy, Ross, Beal.—"One hundred acres nearly all destroyed."

Capt. Winchester, R.N.R., Greenhill, Belford.—"Turnips completely destroyed, some of them three weeks ago."

Mr. James Tait, Estate Office, Belford.—"Swedes and earliest hybrids very badly affected; last sown ones not much and may recover."

Mr. Richard D. Little, North Charlton, Chathill.—"My Turnips are affected with the pest in every field."

Mr. John Craster, J.P., Craster Towers, Lesbury.—"Very much affected, particularly Swedes."

Mr. H. H. Scott, Hipsburn, Lesbury.—"My Turnips are badly affected by the caterpillar."

Mr. John Bolam, Bilton House, Lesbury.—"My Turnips are very slightly affected by the pest; it is scarcely noticeable on them."

Mr. W. Pringle, Branton, Alnwick.—"The caterpillars were first noticed here on Friday, the 24th (of July, Ed.), on two fields of Swedes; so far the whites have not suffered."

Mr. Edw. Forster, Broome Park, Alnwick.—"The pest is on my Turnips, which, however, were well advanced before being attacked, and are as yet holding their own against the enemy."

Mr. T. H. Jobling, Stamford, Alnwick.—"I regret to say my Turnips, especially the Swedes, are affected, the larger ones suffering least."

Mr. Geo. Edw. Coxon, New Bewick, Alnwick.—"So far only slightly affected. Early-sown Turnips seem to have suffered the most."

(Memorandum in Capt. Winchester's report).—* "They are brought here in a cloud by the prevailing easterly winds of our late spring, and I am told they were seen sticking on the light-house windows on the Farne Islands" (this was recorded as occurring on the night preceding July 10th, and the moths were identified as Diamond-backs; see details given further on regarding appearances of vast swarms of moths on the English and Scotch coasts, Ed.) "when the wind was blowing towards the shore. That could show which way they had come."

Mr. Job Tait, Eslington Hill, Alnwick.—"I have examined all my Turnips most carefully, and cannot see any insect upon them."

Mr. L. C. Chrisp, Hawkhill, Alnwick.—"All Turnips more or less affected, yellows especially."

Mr. W. L. Miller, Warkworth (at the mouth of the Coquet, about six and a quarter miles south-east of Alnwick).—"Like my neighbours in this part, my Turnips are affected, the last singled ones suffering the most."

Returning now to the more northerly part of the county, and returning southward by what, as far as I see by map consultation, is n all cases a more inland line, there appears to be a much lesser amount of infestation than at most of the above localities, which chiefly range on or near the coast.—Ed.

Mr. Geo. Grey, J.P., Milfield, Wooler.—"Affected to a certain extent, but I do not anticipate any serious damage."

Mr. Thos. Chartres, Akeld House, Wooler.—"All my Turnips are more or less affected by the caterpillar. The strong robust plants seem to be outliving the attack; the younger and weaker ones will have a hard struggle to pull through."

Mr. Wm. Hindmarsh, Ilderton (about four and a half miles S.S.E. of Wooler).—"My Turnips (Swedes especially) are affected by the pest, but so far the injury, though no doubt it exists, is not apparent."

Mr. J. B. Anderson, West Cottingwood, Morpeth.—"Turnips affected by the pest. Only yesterday morning, the 27th inst. (July, Ed.), I found them. They have attacked the latest sown first."

Mr. Wm. Trotter, S. Acomb, Stocksfield-on-Tyne, Newcastle-on-Tyne.—"Our Turnips here are scarcely affected as yet; it is only by close inspection that any caterpillars are to be found."

Goswick, Beal, R.S.O., Northumberland, July 22nd. From Mr. L. Morley Crossman, on the part of Sir Wm. Crossman. Specimens of Diamond-back attack sent accompanying, with Swede leaves very much injured, in the condition sometimes known as "muslined."— "I beg to enclose leaves of Swedes, which are attacked by some insect. . . . . The land was dunged with farmyard manure, and top-dressed with 2½ cwt. superphosphate and 2½ cwt. vitriolated bones."

(Top-dressing on outbreak of attack given below.—Ed.)

Replies to inquiries in circular (see p. 110), August 11th:—

(1). "The first question I am afraid I cannot answer generally, for accounts seem most conflicting as to loss.

(2). "I top-dressed with small lime first, and then with 1 cwt. of nitrate of soda and 1 cwt. of superphosphate to the acre. I have no hesitation in saying that this latter dressing has been most beneficial. It has given vitality to the plants, without which I think they would have gone off; but fresh leaves have been put out, and since yesterday's rains (the first of any consequence since the attack), I think that, as far as I am concerned, those plants in which the heart was not injured are safe, and will now come to maturity, though maybe very late. Boughs tied to the scufflers seemed to do good where the attack was bad, and where the plants were fairly full grown.

(4). "The Turnips first attacked with me were sown on heavy clay; the land was ploughed in the autumn very dry, and ploughed again in the spring very deep, and in very dry weather. The land had 20 loads farmyard manure, 2½ cwt. of superphosphate, and 2½ cwt. of vitriolated bones to the acre. No salt was used.

(5). "The weather last autumn, as far as I can remember, was dry, and I noticed no weed in great quantity.

(6). "In one part of the field first attacked was a good deal of Charlock, and at this point the attack began, the Charlock being entirely consumed; but whether this points to the caterpillar being especially found on Charlock, I cannot say.

(7). "Starlings are especially useful in clearing the caterpillars, and I feel convinced that the Rook is also most useful, for this year, especially since this attack, have they been very busy amongst the Turnips. I also notice a great many Peewits and Gulls about."

Branton, Alnwick, Northumberland, August 11th. From Mr. Wm. Pringle. In his letter accompanying the replies to the circular, Mr. Pringle observed:—"I would not have detected the caterpillar so soon on my Turnips if I had not been staying for a fortnight before July 24th at Bamburgh on the east coast. In that time I saw whole fields taken off; some were ploughed up and resown; these were mostly Swedes; they were all well forward, a great many being closed over the ridge.

"We are fourteen miles from the sea, close to the foot of the Cheviot Hills. There is no doubt the moths have come from the sea, as the Turnips are more affected as you get nearer the coast. Here we have suffered very little damage."

Replies to inquiries in circular (see p. 110), August 11th:—

(1). "I have suffered no loss, as I took means to remove the caterpillar before they had time to do any damage except making holes in the leaves in some parts of the field.

(2). "By keeping the scufflers going with birch branches attached. I sent a letter to the 'Newcastle Daily Journal'* (which I enclose); it was copied by the local papers, and has been tried by several people all over the county. Where the Turnips were brushed before the caterpillars had time to do much damage, it removed them in large numbers. I tried dusting with quicklime on the under side of the leaf; it did not kill them. Going back next morning I found they had eaten part of the leaf, lime and all, and were still as lively as possible. I also tried paraffin and water, one to fifty, put on by a garden syringe with a very fine rose; the only effect I could see it had was keeping the birds off that part of the field.

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* "*The caterpillar plague.*—Having tried most of the remedies recommended for the destruction of the caterpillar, the most effective I have tried are birch branches tied on the front of the scuffler, and projecting well over on both sides so as to completely cover the drills on each side. By this means each drill is gone over twice, and the insect completely cleaned off the plants and buried up by the scuffler. The caterpillars were first noticed here on Friday, the 24th; they have not yet had

(3). "The cold weather and heavy rains we had during the week ending August 1st killed great numbers.

(4). "Part red clay, but mostly whinston gravel. All the land I have Turnips this year (100 acres) has been limed within the last four years at the rate of 7 tons shell lime per acre. All my Turnips are after Oats. The land was all ploughed during autumn and early spring about ten inches deep; it all had two furrows just before sowing. Thirty acres of Swedes had 15 loads farmyard manure, 5 cwt. Thomas's phosphate powder, 2 cwt. kanit, and 1 cwt. nitrate of soda put on the ridges and split in just before sowing; 10 acres had the same quantity of farm manure ploughed in during autumn. Also the same artificial per acre, and the ridges split before the seed was sown. After having the caterpillars brushed off, I top-dressed the whole with ½ cwt. nitrate of soda and 2 cwt. salt per acre. Now it is scarcely possible to tell whether anything has ever been on them, they are looking so well.

(5). "Here we do not clean our land until just before sowing; the weather at the time could not have been better for cleaning land. I never sowed my land in better order. They were all sown by May 26th, which is considered early for this district. There was no particular weed noticeable.

(6). "In examining the fields of Swedes, I found a few caterpillars on some stray plants of Charlock, but nothing like the numbers in proportion there were on the Swede leaves. I have 60 acres of yellows and whites, and the caterpillars have scarcely been noticed on them at all.

(7). "There have been thousands of Starlings, green and golden Plovers, Gulls, Chaff- and Greenfinches, frequenting all my Turnip fields for some weeks, and I have no doubt they have cleared thousands of caterpillars off daily during that time."—W. P.

Mr. Hy. Annett, writing from *The Cottage, Widdrington, Northumberland*, noted.—"As large areas of Turnips are apparently being

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time to do the damage caused along the coast, and by keeping the scufflers going I hope to be able to save the greater part of my crop."—Wm. Pringle, Branton, July 29th, 1891.—From 'Newcastle Daily Journal,' July 30th, 1891.

ruined in this immediate district through the attacks of what I presume is a caterpillar, I forward by same post specimens of the 'worm,' and the results of their handiwork." Specimens of Diamond-back Moth caterpillars were sent accompanying.

Marden, Whitley, Northumberland, August 12th. From Mr. Fenwick Wilson.

Replies to inquiries in circular (see p. 110):—

(1). "30 acres of Turnips and Swedes affected to the average amount of £5 per acre. Most damage is done near to hedges; for a considerable distance no Turnips whatever are left.

(2). "Only measure taken was heavy dressing with salt sown broadcast, which did not appear to do any good.

(3). "Caterpillars appeared during very dry weather, which was followed by very heavy rains and thunder showers, but they had no effect on caterpillars, which, in fact, did most harm during and immediately after rains.

(4). "A. Moderately strong; was deeply ploughed in spring, twice cross-ploughed, and well cultivated. B. Manured with town manure on stubble and ploughed in, and heavily manured with fold manure in drills just before sowing seed (no salt used as manure).

(5). "Practically no weeds.

(6). "Affects Charlock about the same as Turnips.

(7). "Starlings and Lapwings have done much good in clearing caterpillars; Sparrows and Rooks are occupied with early Oats; no time to spare for caterpillars."—F. W.

Cheviot House, Berwick-upon-Tweed, July 28th. From Mr. F. Norman. After some observations on the great extent of Turnip land in the district, and the wide spread of the caterpillar scourge on the crop, Mr. Norman observed:—"I was examining the Turnips last evening in the fields. A pitiable sight. The leaves of acres upon acres quite bleached and frosted in appearance from the light of the declining sun shining through the epidermis, which the caterpillars considerately leave intact.

"In this district the cocoon-spinning has begun, and is fast proceeding. The terrible idea now forces itself forward,—Will there be another brood of moths, eggs, and caterpillars from these chrysalids *this year* to attack the present plants which survive, and those of a second sowing where that is ventured upon?"

October 6th. The following remark by Mr. Norman accords with that of other observers who notice the great leaf growth following on the rains.—"I am glad to tell you that the Turnips in this district are very good indeed. The truth was that rain came on in the nick of time, and enabled the tops to more than recover themselves from the state of debility to which they had been reduced by the caterpillar."

October 26th. The following observation also accords with only too many others as to the deficiency of bulbing which often accompanied the splendid leafage.—" Since I wrote to you I have had an opportunity, in going the rounds here, of speaking to some of the farmers of the district about their Turnips. They agree that the Turnips are looking splendidly, but nearly all say that they are behind in bulbing owing to the severe check which they received from the caterpillar."—F. N.

SCOTLAND.

BERWICKSHIRE.—*Gunsgreen, Fyemouth, N.B.*, July 21st. From Mr. James Gibson, with specimens accompanying. A large number of specimens of Diamond-back Moth caterpillar were sent, and of these a much larger proportion were still young than was the case with specimens from more southerly localities. The leaves forwarded were about six to eight inches long, and about three-quarters of the leaves might be estimated as destroyed in the case of those least attacked. Some were reduced to little but the veins and ribs, with the remains of just the filmy cuticle of the upper side of the leaf connecting them. —ED.

Mr. Gibson wrote on July 21st:—" An unusual pest has recently fixed on the Turnip crop in this particular part of eastern Berwickshire. Until ten days ago the Turnips appeared quite healthy, and promised to be an abundant crop. When working through the fields end of last week, I observed a few of the leaves drooping, and on examination found small perforations on the leaves. Minuter examination showed that some small caterpillar, or other animal, or insect had wrought the mischief.

" As the weather was showery, I thought that the plant would overcome the damage; but instead of improving, the plants are disappearing by acres, and what looked a promising crop ten days ago, I fear will now prove a complete failure.

" Not only the damage is not confined to my own farm, but various holdings within an area of three miles appear to be similarly affected."

On the 28th of July, Mr. Gibson wrote:—" All round the coast here the plague of caterpillars is very prevalent; inland it is not so bad."

Replies to inquiries in circular (see p. 110), August 10th:—

(1). " I have about 80 acres under Turnips this season; from this area I do not expect to have more than 80 acres, and this a very poor crop indeed. As far as I observe, the attack has been very severe along the coast here from within three miles of Berwick-on-Tweed, stretching for ten miles, and about one and a half miles inland.

Beyond that distance inland it gradually improves until the crops promise to yield very abundantly.

(2). "My experience was that lime or soot dressing had very little, if any, effect. Nitrate of soda or superphosphate I did not try, as the pest was making such rapid progress; and (as I advised you) I tried sulphur fumigating, as previously explained, which took the caterpillars off the leaves, and thereafter I ploughed them in.*

(3). "I am of opinion that the heavy rains, high wind, and cold weather that we had for two or three days had great effect in checking the ravages; the constant beating of the rain, the tossing by the wind, knocked them off, and the chill appeared to deaden or paralyze them.

(4). "The land round about here is particularly adapted for raising a Turnip crop. It is autumn cultivated, and is ploughed to a depth of not less than nine inches. Part of the land is manured with curtain dung ploughed in, and when the Turnips are sown, artificial manure is used by being sown in the drill. No salt is used in this quarter; the land does not require it, owing to the constant presence of saline particles from close proximity to the sea.

(5). "The weather here last autumn was fairly dry, nothing abnormal, and allowed the ground to be well cleaned. No particular rush of weed was observed.

(6). "Yes, from my own observation; and any of this weed which happens to be among the Turnips is stripped to a skeleton.

(7). "As far as I have seen, Crows and Sparrows were the birds that devoured the caterpillars chiefly. Sea Gulls, although following the plough in thousands, and during the manuring time, did not take to the grub. The Crows had to be 'herded' by boys from the Potatoes, when all at once they were observed to leave the Potatoes for the Turnip fields, and were no doubt helpful in drawing attention to the scourge in the first instance. Although near here I observed the Starlings when they came here in clouds in the early spring, and where they yet remain, I cannot say that I have seen them feeding on the grub in any numbers."

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* Mr. Gibson here refers to a plan, arranged by his steward, for fumigating Turnips by means of a sort of sledge about ten feet long, and wide enough to cover two drills of Turnips. At the two ends and in the middle, "under the upper side of the top floor there are three pots in which pure rock sulphur is kept burning. The apparatus is open at both ends, save for curtains of sacking."

This apparatus was drawn by one horse, and the united effects of stupifying the grubs by fumigation, brushing them down by rubbing of the sacking, and finally burying the fallen grubs by a small plough following the fumigator, was found to answer well. I have, however, been afraid to recommend it, as without careful management the apparatus might injure the Turnip, or the sulphur fumes possibly be injurious to the leafage.—Ed.

On October 20th Mr. Gibson noted further:—"My worst anticipations regarding the destruction of my Turnip crop have been realised. In all my experience I never saw such a failure. The fields are more like a wilderness than rich arable land."—J. G.

HADDINGTONSHIRE.—*Queenstonbank, Drem, N.B.*, July 23rd. From Mr. John A. Begbie.—"I send you a box containing some leaves of Swedes and yellow Turnips, in which you will find a caterpillar which appeared on our Turnip crop a few days ago, and which has already done a great deal of harm." (Specimens sent showed that some of the Diamond-back caterpillars were then spinning cocoons for change to the chrysalis state.—ED.) "The whole of this district along the sea-shore, from Dunbar as far as, say, about thirteen miles from Edinburgh, appears to be attacked; but inland I have heard of no damage—indeed, a friend who farms within ten miles of me (but inland) says he has none of it.

"In Fife I hear it is also bad, in some places so much so that they have had to plough up the crop. We thus have it on both sides of the Forth. Whether it is confined to this district or not I do not yet know.

"Early Swedes and yellows in some places have escaped, while later plants are stripped to skeletons; but elsewhere I have seen an early field of yellows quite white, and no doubt they will shortly be eaten bare.

"We have had very high temperature, and a very short rainfall in June, and up to this last week, when heavy rain fell on Tuesday and Wednesday last, and to-day, the caterpillars are, I think, much fewer. I am top-dressing with nitrate, which I hope may rush the crop (90 acres) out of trouble."

Replies to inquiries in circular (see p. 110), August 15th:—

(1). "*Estimate of loss.*—Crops which were far on have suffered very little, while those which were later in the same district, and even in the same field, have been almost, or sometimes totally, destroyed, so that an estimate of loss is, at the present time, impossible. A 43-acre field of Swedes of mine looked miserable about the end of July; but now, having been top-dressed with nitrate, and pushed on by moisture and heat, it is looking, except in a few spots which were badly bitten, a very fine crop. And until the end of the year it will not be seen if the damage done in July has affected the yield. If we have open growing weather in the back end, the chances are that the loss of time and damage may be fully made up.

"17 acres of yellows on my farm have suffered severely, and I have sown 150 lbs. of Rape, and harrowed it in between the drills of the Turnips. The loss of Turnips may be overhead 80 per cent. In some places the whole crop is gone; in other spots it is not touched.

"26 acres yellows, where early sown and got rain, came away wet, and there is practically no damage; where later it is considerable, perhaps 20 per cent.; but taking it overhead on that field the damage may be only 5 per cent., as the larger part of the field is all right. This is an illustration of how difficult it is to form any reliable estimate, or indeed any estimate at all.

"In this field I left about two acres of wet dirty land some way into the field and pushed on with the rest; these two acres were therefore later. On both sides of this strip the crop is splendid, while it was eaten very badly.

(2). "I sowed 1 cwt. per acre of nitrate of soda on 48 acres Swedes and 10 acres yellows, and 2 cwt. soot on one acre Swedes. All have come away well, and done better in resisting, or rather overcoming, the damage, than what was not top-dressed. Grubbing, I think, has helped crops which were far on, by the rough disturbing of the leaves.

(3). "Heavy rain marked the first stoppage of damage, but I think high winds and a lower temperature on the night of the 22nd of July, and during the last four days of that month, were also of great benefit.

(4). "26 acres stiff clay, ploughed in January medium depth. Manure—4 cwt. superphosphate, 37·40 per cent.; 4 cwt. dissolved bones; 2 cwt. nitrate. No salt.

"17 acres light sandy land, ploughed in April. Manure—3 cwt. bone meal; 1½ cwt. bone flour; 1½ cwt. cod fish guano; 2½ cwt. superphosphate, 26 per cent.; ½ cwt. nitrate. No salt.

"48 acres stiffish land, ploughed in February. Part dunged, on the stubble of which 10 acres got 4 cwt. slag; 1½ cwt. bone flour; 1 cwt. nitrate; and 18 acres got 2 cwt. super., 37·40 per cent.; 2 cwt. dissolved bones; 1 cwt. nitrate. The other 20 acres with no dung got 3 cwt. super., 37·40 per cent.; 3 cwt. dissolved bones; 1½ cwt. bone flour; 2 cwt. nitrate. No salt.

(5). "The season was dry. Rainfall as follows:—1890: October, 2·61; November, 3·62; December, 1·65. 1891: January, ·85; February, ·15; March, 3·14; April, ·58. Cannot say I noticed anything unusual in the weed line.

(6). "Yes.

(7). "I am told that Crows and Starlings were seen among the caterpillar-eaten Turnips. I must say I saw them there no more than usual; and Sparrows and smaller birds preferred the Barley." *
—J. A. B.

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* The following "general remarks" of Mr. Begbie's are, I think, of very serviceable interest, relatively, not only to the effect of amount of rainfall on the infestation and on the condition of the attacked crop, but also the effect of the

FIFE.—130, *North Street, St. Andrews, N.B.*, July. From Mr. Andrew Balsillie. The first publicly recorded observation of the appearance of the Diamond-back Moth during the past season was, as far as I am aware, that made by Mr. Andrew Balsillie, of St. Andrews, and communicated by him at the time (on July 21st) to the 'Scotsman' newspaper. Afterwards, on request for information, he wrote me that on the very last days of June an extraordinary number of small grey-brown moths were observed all along the eastern seaboard of the county of Fife infesting the Turnip fields. Their appearance was coincident with a period of long-continued drought, and though the plants had brairded, they were making exceedingly little progress. On Monday, July 20th, or as nearly as may be three weeks after the appearance of the moths, both Swede and yellow Turnips presented the appearance as if lime had been sown on them. On looking more particularly, it was found that the plants were infested with small green caterpillars which had eaten the under side of the blade, leaving the thin film on the surface. In this way whole fields were destroyed. In other cases portions of a field seemed to escape with comparatively little damage.

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method of fall, *i. e.*, whether penetrating, or in small quantities rapidly drying up. Mr. Begbie also alludes in the last lines of his remarks to the high minima of temperature at the time of appearance of the pest, which (as he remarks) was very likely to help their development. The minute meteorological details, with which he favoured me, are too long for publication here.—ED.

"GENERAL REMARKS.

"After the frost of last season the land was in fine order, and Turnip sowing was commenced about the 1st of May. With a fair amount of rain in that month the early-sown fields got well away, though for a time they were kept back by cold east winds. In June we had only ·28 rain, and though the heavy dew and hoar kept the brairded Turnips growing, the unbrairded seed came away in patches. Up to the 15th July ·65 rain fell, but in such small quantities as to do only the growing Turnips good. On the 17th and 18th July, the caterpillar appeared and simply ate up all the weakly plants which had come away in patches, and did much damage to fields which had stood still in June, not being far enough on in the shaw to catch the dews and hoar.

"Heavy rain on the 21st and 22nd, and a lower temperature, marked a change, and by the end of the month the caterpillars were much fewer in number, and now (15th August) are entirely away. The rain of 21st and 22nd July brairded all seed which was yet to come, and these are all now singled and doing well, though it will take a very open growing back end to make them a crop at all.

"I quite think that if we had had rain in June, the whole crop would have been as much beyond the reach of the caterpillar as the early-sown crops, which got well away in May, proved themselves to be.

"I enclose a note of temperature, &c., in July for three years, and on charting the minimum readings the high temperature from the 13th to 21st July of this year is very apparent. This may have helped the development of the plague which appeared during that time."—JOHN A. BEGBIE.

Replies to inquiries in circular (see p. 110), August 11th:—

(1). "Evidences of the ravages of the caterpillar may be seen at least six miles inland, and I should estimate that from a third to a half of the crop has been destroyed. Resowing has been attempted in many cases, but it is yet too soon to say what the result may be. On Saturday I observed a second brood of the moth, but in numbers not nearly so numerous as on the first occasion.

(2). "Soot and nitrate of soda have both been freely used (near St. Andrews, Fifeshire) in this district, but I am doubtful if either had much effect upon the caterpillar. The remedy was attempted too late; in fact, just at the time the caterpillar was spinning its cocoon. It was beneficial, however, in a secondary manner, as it would push the plant into more vigorous growth. In other cases scufflers with boughs were sent through the fields.

(3). "We were certainly fortunate at the time the attack was worst in having heavy rains, or otherwise I believe the result would have been even more disastrous.

(4). "In some cases whole fields were destroyed; in other cases portions of a field seemed to escape with comparatively little damage.

"On inquiry into the reason of this, it was at once apparent that it depended to a large extent on the nature and condition of the soil, and the state of plant-growth at which the attack had commenced.

"Early-sown Turnips in good soil, both as regards mechanical and manurial condition, survived the attack and continued to grow, while on hard clay soils, and on back lying soils trending to the north, and where the attack had commenced shortly after or during thinning, the plants were entirely eaten up.

"There is no doubt that the best preventive is to have the land in high-class condition. In a field, for example, which was well done to, a portion which got an extra dressing, from the more vigorous growth of the plant, seemed almost to have escaped.

(5 and 6). "So far as I have observed, there was nothing exceptional in the weather during the autumn to account for the visitation; nor have I heard of any particular weed unusually noticeable. It ought, however, to be noted that the attack has been found to extend to all members of the Cruciferæ (excepting Cress),* including Brussel Sprouts, Cauliflower, Raddish, Wallflower, Charlock, &c., so that there is ample opportunity for the perpetuation of the species during the winter.

(7). "I have no doubt but that the Starling and the Sparrow have assisted largely in mitigating the evil. Possibly the Rook may have also eaten a number of the caterpillars, but of that I am not certain."—A. B.

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* Cress also is liable to infestation. I had specimens of Cress plants, which had been left for seed, sent to me from near Kelvedon, Essex, with cocoons on them then containing spun-up caterpillars or chrysalids of the Diamond-backs, from which the moths presently developed.

On the 28th of Dec., in reply to my inquiry requesting information as to yield of Turnip roots, Mr. Balsillie favoured me with the following observations:—"It is the general experience in this district that where the Turnip crop escaped complete destruction by the Diamond-back Moth, the yield is about 25 per cent. under an average. Some weeks after the ravages of the caterpillar had ceased, the luxuriant leafage gave promise of an excellent crop, and farmers were congratulating themselves, after the gloomy prospects of August, that they would have about an average yield. Had the weather been propitious in the autumn months, their hopes would in all probability have been realised; but the rainfall, both in October and November, was excessive, the soil became water-logged and cold, and bulbing was almost at a standstill. The result was seen when storing came on, in the large proportion of small Turnips. The check which the plants received in July was something like a month taken from their growth, and the later conditions being unfavourable they did not have an opportunity of making up leeway. This was also noticeable in re-sowings, which never came to anything."—A. B.

Coates, Largo, Fife, July 7th. From Mr. John Lee. At this date Mr. Lee forwarded to me specimens of small moths (of which some samples had been sent me in the previous week) for further investigation, but, having been rubbed in the postal transmission, I had not been able to identify them as Diamond-backs. In this case also I could not name them with certainty; but from the nerving of the wings, where the scales forming the pattern was rubbed off, they appeared to be *Tineas*, and were of the size of the Diamond-backs; therefore, as there was a severe outbreak of caterpillars about three weeks later on the fields where the moths were seen flying about, it scarcely seems open to doubt that these were part of the flock of Diamond-backs which appeared on those parts of the coast. On the 7th of July, Mr. Lee noted that no caterpillars were seen in the Turnips although carefully searched, but the moths were very numerous, especially in those Turnip plants which had not been singled.

Replies to inquiries in circular (see p. 110), August 14th:—

(1). "I should say the damage done will not amount to one-fourth of the whole crop grown.

(2). "Several farmers have put in boughs of trees in the scufflers; but none that I am acquainted with have applied anything but nitrate of soda, not with the idea of it killing the caterpillar, but to force on the growth of the Turnips. So far as brushing them off is concerned, I find they again ascend the Turnips from the ground;

and if buried under three inches of earth at once find their way to the surface.

"I put on my ploughs a good firm bundle of Wheat straw, bent down at the ends, so as to rub the under part of the leaves without damaging them, which the boughs are apt to do.

(3). "I do not think rain has any effect in killing them. A high wind I fancy is more effective. The land on which the Turnips are worst is generally stiff, but not always.

(4). "Those plants on parts of fields which are destroyed are generally those which were not in a thinning state when they were attacked.

"The depth at which the land in Fife is ploughed in stubble is from six to eight inches. The manure used is very generally half-dung and some light manure. No salt.

(6). "The caterpillar seems to eat the Charlock much in the same way as the Turnips, neither more nor less.

(7). "During the time the caterpillars were most plentiful, the Starlings and thousands of smaller birds might be seen feeding on them."—J. L.

Rathillet, *Cupar*, *Fife*, July 20th. From Mr. Dav. Carswell, with Diamond-back Moth caterpillars sent accompanying, as specimens of a grub which was eating, to a large extent, a field of yellow Turnips belonging to the sender, and on the following day Mr. Carswell communicated further:—"Since writing you yesterday, I have heard in the market here to-day great complaints of the green larva, specimens of which I sent you yesterday, all over Fife; some fields are almost eaten up.

"When in the field this morning I saw a great many white moths, which, I presume, are the progenitors of the larva. On looking at my two fields of Swedes I find them both affected. It is apparently to be a great scourge in Fife."

On July 23rd Mr. Carswell wrote further:—"Notwithstanding very heavy rains, I find the caterpillars still very numerous on the under side of the Turnips this morning, and a great many moths flying about, so that I am afraid a Strawsonizer and water will have no effect. Some of my neighbours are trying nitrate of soda and superphosphate, and another soot. These may stimulate the crop, but I am afraid will do nothing to destroy the caterpillar, as it seems impossible to get at it, unless, as you propose, by brushing it off. It appears as if whole fields would soon be completely eaten up."

On the 11th of August, Mr. Carswell noted that "the Turnips on this farm have improved very much since the rains and some cold nights. There are now very few caterpillars to be seen; but on one field especially, and that the one that was most affected, the moths are in thousands. It is a field of yellow Turnips, and was the last field sown."

Replies to inquiries in circular (see p. 110), August 18th :—

"I have been making inquiries into the ravages of the caterpillars of the Diamond-back Moth in this district, and beg to give the following answers to your questions :—

(1). "Estimate of amount of loss about one-fifth.*

(2). "Nitrate of soda, &c., have been very beneficial; do not know of other remedies having been tried in this district.

(3). "Heavy rains and cold nights did immense benefit.

(4). "Land generally black loam on whinstone; some fields on sand, late sown, were worst. No difference observable to any extent in time or manner of ploughing. Manures—Nitrate of soda, guano, Liebig's meat meal, superphosphate, bone meal and flour; some cases kanit. No salt.

(5). "No.

(6). "No.

(7). "Yellowhammer, Wagtail, and Linnets."—D. C.

On the 7th October, Mr. Carswell favoured me with the following note as to state of Turnips up to date :—"The Turnips here improved very much after the rains, but they are not in many instances bulbing well, and will be a small crop, unless we have an open winter; and this I attribute very much to the severe check they got from the caterpillars, although latterly we have had too much rain and too little sunshine."

Seed and Nursery Establishment, Stirling, N.B., July 23rd. From Messrs. W. Drummond and Sons, regarding attack of caterpillars of Diamond-back Moth.—"We have complaints of it from the east and north of Fife, from Kinross, and from Forfarshire; in nearly all cases from the districts near the Firths of Forth and Tay, where the rainfall during the early part of summer has been less than in most parts of Scotland. Over a considerable part of the area heavy rain has fallen since the beginning of the week, and we hope to hear that it has interfered with the ravages of the caterpillar."

June 24th. "Additional specimens have reached us this morning, and we hear that there are slight attacks in our own neighbourhood."

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* "My report applies to the north of Fife. Turnips have improved very much of late, and it is difficult to estimate the loss, as so much depends on the future, and whether or not we have early frosts. Land in the highest condition and properly cultivated has suffered least.

"In my own case, having given the Turnips a large quantity of manure when sown, I did not give anything afterwards, and the loss will not be one-tenth; others one-third. The late-sown Turnips as a rule have suffered most. The east coast of Fife seems to have suffered more than inland."

Replies to inquiries in circular (see p. 110), August:—

(2). "Light ploughs and other implements, with brushes attached, were generally thought to be very serviceable; and it was remarked that the mere action of the horses' feet brushed off many of the caterpillars where the leaves were large.

(3). "Heavy rain *not* thought to reduce caterpillar, and to be beneficial only in promoting vegetation.

(6). "Very destructive to Charlock."—W. D. and Sons.

Letham, Leven, Fife, N.B., July 24th. From Mr. David Crole, jun. Specimens of caterpillars of Diamond-back Moth sent accompanying, some full size.—"I lease an arable farm in this district (east of the county of Fife), and the Turnip crop is one of the most important. Within the last few days the Turnip crop on this farm has been attacked by what I have been told is the larva of the Diamond-back Moth. The leaves have been stripped, and also holed (perhaps the latter, the first operation in the depredations). We have not had such an experience before in Turnip cultivation in this county, nor I believe in Scotland."—D. C.

Kenneston, Leslie, Fife, N.B., July 25th. From Mr. J. Beveridge, with specimens of Diamond-back Moth caterpillars accompanying, some spinning up.—"I am sending you some specimens of caterpillars that have attacked the Turnips in this neighbourhood. . . . . I have 20 acres that seemed all right a week ago; now it is riddled, and seems in a fair way to be entirely destroyed. I am dressing it with nitrate."

Replies to inquiries in circular (see p. 110), August 13th:—

(1). "I can form no estimate yet as to the loss, as the Turnips are growing so fast now that they may be a fair crop yet, except about one acre out of twenty, which is totally eaten up.

(2). "I put on about 1 cwt. of nitrate and 1 cwt. of salt per acre. I do not think this had any direct effect on the caterpillar, but has helped the Turnips very much. We have also been hand- and horse-hoeing as close to the Turnips as possible.

(3). "The heavy rains we have had have done more good than anything else; even the first shower after the attack began had a wonderful effect. My neighbours all concur in this opinion.

(4). "The land is alluvial deposit and sand, and formed part of the old bed of Loch Leven. It was five years in grass, Oats last year, and was ploughed in December rather wet, and not touched again till June 1st. The Turnips were made with farmyard manure and about 5 cwt. of nitrate of soda and super.; no salt.

(5). "The weather after November last was very wet; but noticed no particular weed.

(6). "No Charlock.

(7). "I have seen no birds near the field except Larks."—J. B.

Easter Kincaple, St. Andrews, Co. Fife, N.B., August 8th. From Mr. George Dun, with specimens of the upper part of Charlock ("Skellock") stems sent accompanying, with the leaves showing characteristic workings of Diamond-back Moth caterpillar. (Turnip leaves very much injured also forwarded, and some specimens of the caterpillars, Ed.) Mr. Dun had previously reported, on the 3rd of August, that he had fifty acres of Turnips badly eaten by caterpillars. On the 8th Mr. Dun wrote further:—

"I send you a few of the leaves that have been attacked. I noticed my Turnips attacked three weeks past yesterday, and the moths in droves. On Wednesday last I saw again a large number of moths, but not so numerous. I am afraid they are to master ten acres of Swedes, although in the beginning of this week I had hoped they were to turn out a fair crop; they started with me when dunged in the drill, the Turnip plant, after being thinned, sitting dry on the top of the drill. I send you the only Skellock I can get in the field, but they were quite as badly infested as the Turnips (the field is clear of weeds)."

Replies to inquiries in circular (see p. 110), August 10th:—

(3). "The growth started after a very heavy thunder-shower on the afternoon of the 22nd July; on the 27th they showed decided improvement. Yesterday we had a fine heavy rain, and to-day the crop is looking better.

(4). "My Turnip break was all ploughed again in spring, and reduced to a fine mould, and brairded with the aid of showers the last week of May. I noticed my Turnips not thriving, and all holed on 17th July in field of Swedes, 25 acres in extent, drilled east and west. This field lies 20 ft. above sea-level; sandy subsoil, heavy loam in high condition, within 500 yards of the River Eden, where the tide rises to daily. Fourteen acres of this field were dunged during winter with 10 loads of dung; the end rigs also. The remainder of the field was dunged in the drill with 10 loads well-rotted farmyard dung, both plots getting 3 cwt. best herring guano, 3 cwt. superphosphate, and ½ cwt. nitrate per acre, sown when the land was drilled, and sown with Turnip. On 20th July I dosed the whole Turnip crop on my farm with ½ cwt. superphosphate and ½ cwt. nitre, sown with two hands, taking two drills at a time, so as to reach and protect the heart of the Turnip from the caterpillar.*

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* I have omitted to mention that my Turnips, where dunged in the drill, have been by far the worst. My yellow Turnips are making a better recovery than the Swedes, but are nearly all double shawed.

(5). "The weather has been exceedingly dry here for two years, except on two occasions; no water has run off the surface.

(7). "I consider the Starling the most useful bird we have in clearing the caterpillar; they have been very active of late, and very numerous. Sparrows are too numerous, and are against the Swallows."

Kirkmay, Crail, Fife, N.B., August 19th. From Mr. John Duncan. —"In this district (East Neuk of Fife) the weather has been very dry, there only being 6½ in. of rain for the first six months of the year. In July, when the moth and caterpillar appeared, the Turnips were at a standstill for want of moisture, and I am of opinion that to that cause alone can be attributed the attack, as vermin of some sort is sure to attack a plant if it is unhealthy or not growing. As an example, I have a field of Swedes, on cold-bottomed land, which had never stopped growing, and have therefore scarcely been touched, except on the two end-ridges, where the crop was not so vigorous; whereas another field, on very dry light land, has been considerably damaged. Again, six miles to the westward, where there has been more rain all the season, the damage is not so great as in this corner. The moth is still very plentiful, but as we have now had rain, I do not fear a second attack. I have often observed the same moth in previous years in walking through old pastures, and at sides of roads, hedges, &c."

Replies to inquiries in circular (see p. 110), August 19th:—

(1). "I cannot give an estimate of my loss further than to say that it has made my crop, *where affected*, four weeks later; but on a farm in this neighbourhood one-third of the crop is almost destroyed and part ploughed up, and the other two-thirds were much affected.

(2). "I have tried no fertilizers, but have no doubt but that nitrate of soda would help to push on the crop, and thereby lessen the amount of damage. On a light land farm of mine in the next parish my grieve tied boughs to the *front* of a horse-hoe, and brushed off numbers of the caterpillar; the tines coming after buried them in the earth. The fields so done have not suffered much.

(8). "Heavy showers, with an extremely low temperature on 28th July, destroyed great numbers.

(4). "As said before, crops on dry light land suffered most; the land was ploughed in autumn and early winter, and worked and cleaned before seed-time. The same manure was used for all Turnip crops, *viz.*, farmyard manure, Ichaboe guano, and superphosphate of lime.

(5). "Previous autumn wet, but did not interfere with cleaning of Turnip break. No particular weed noticeable.

(6). "Having no Charlock, I cannot say.

(7). "The *Starling* is *by far* the most useful, and the Rook to a certain extent."

On the 12th of October Mr. Duncan further added :—" The earlier-sown Turnips, which were better able to bear the attack, are now a fair crop; later-sown ones have now a lot of leaves, but the bulbs are small."

FORFAR.—*Inverpeffer, Carnoustie, N.B.*, August 11th. From Mr. J. Swan.—"If not the first victim, I was the first in this county to note the sudden attack, and sent off specimens of plants to Messrs. Drummond. We left off working (*i. e.*, hoeing) yellow Turnips on Tuesday, 14th July, in a field, fearing nothing, except that we were parched with drought, and was absent for two days till Friday, July 17th; and on Tuesday evening neither I nor any of my workers saw any sign of danger or damage. On Friday morning not a single plant in ten acres was safe; all the leaves like lace. The next field, over the wire-fence, was Swedes—begun to meet in drills—and the large, broad, luxuriant leaves were a pitiful sight; and in both fields the caterpillars were in millions. There were evidently two broods at work, one ⅞ in. to ⅝ in. long, the thickness of a knitting-needle; the other ⅜ in. to ⅛ in. long, and small in proportion. In this field of Swedes—20 acres—two acres had been sown a second time with yellow seed, and they grew so rapidly as to be thinned on the seventeenth day after seeding, the quickest, in my experience, in 50 years. In 48 hours not one plant left alive. Westward ho! was the word, and, passing two fields of Wheat, entered a second field of 20 acres saved, and these were so extra luxuriant that the moth failed to do so much damage; but 6 acres yellows in west of same field were all but killed; they are only now recovering. This evening I find a late division of 9½ acres yellows, all thinned a fortnight ago, not 100 plants left; resown a week ago with Rape-seed between the rows of Turnip, so that, should the Turnip perish, the Rape would be well started; and I have to report a fine braird of Rape everywhere, whether sown over and among moth-eaten yellows or where the yellows are clean away."

Replies to inquiries in circular (see p. 110), August 11th :—

(1). "Over an area of 30 acres Swedes, 25 to 30 per cent. of deficit must be recorded, and over 30 acres yellows 15 are a total loss, and only Rape instead; the other 15 may make 50 per cent. of average. The money loss cannot at this early date be accurately recorded.

(2). "Nitrate and super. the best stimulants, and unfailing in good results; no dry or dust applications, nor any chance of Strawsonizer or sprayer; but practically, over 60 acres, no time, or water, or machines to overtake the work.

(3). "Heavy rain did much good falling on dry parched surface, dashed the sand and mud on to under side of leaves, and made the life of the caterpillar no sinecure.

(4). "My land all natural Turnip land; loam with sand, or sandy loams and clay loams. First field attacked was twice scarified in the fall of 1890, and all stubbles and weeds raked off; deeply ploughed (8 in.) in February, and again in May, and dunged in drills. Where rotted dung was applied, the plants have outlived the attack; where courtyard dung (fresh), the plants all perished.

(5). "Fine autumn till 20th October; after that, till 1st December, very wet. No particular weeds.

(6). "Scarcely any Charlock on farm; Couch the chief weed. Will send specimens of two weeds which prevail.

(7). "Starlings, Sparrows, Chaffinches, and Linnets very plentiful, and all been most industrious."

Oct. 6th. Estimate of damage resulting from attack:—"The first field of Swedes is so extravagantly luxuriant in shaws (*Anglice*, Tops) as to lead the casual observer to conclude, 'No harm done; splendid crop.' But examine the shaws or top leaves, and you find a double number; the outer rows are the original perforated leaves, in the centre of which have grown up a later or new set of stems and leaves; but examine the bulb, and you find it half the size. The same applies to the yellow varieties that are left. One-third of an average crop, in weight of bulbs, is rather under than over the deficit."

On Dec. 23rd, Mr. Swan, in reply to my inquiries as to what the amount of loss might have proved to be when time of storage or use of roots arrived, favoured me with the following details, which I give *in extenso*, as they meet several considerations of useful interest. The amount of loss; the enormous growth of leafage, so misleading to those unacquainted with the bearings of this shaw for service; the very peculiar method of start of the second growth of leafage; and the serviceableness of sowing Rape-seed to fill in amongst the damaged Turnips. Mr. Swan wrote:—

"First, as to Swedes; I had a firm conviction all through September, October, and November that we were to have a great deficiency in bulbs. The leaves, perforated in July, partly fell off, but a large portion remained, and out of the centre of the first shaw a second growth of leaves sprang up, and where the land was in good condition, whether clay, clay-loam or black land, or sandy loam, all through October not a drill could be distinguished, so rich, rank, and luxuriant was the foliage.

"I was set down as a 'growler' by a party of friends when they looked over a field of 25 acres, and before they walked into it; that field is now, at date, two-thirds cleared, and the produce is 14 loads—perhaps, I may say, tons—as against 28 to 30 seven years ago, being worked in seven years' rotation; and in 1877—a miserably wet season —24 tons. Only a section of three or four acres in that field had Rape-seed broadcasted in the third week of August, where the plants were too open.

"In the other field, close by the sea-shore, all Swedes, two acres were drifted out and resown, and, you will recollect, sown with yellows, and were thinned just three days previous to the first attack, and completely perished; those two acres, and perhaps over five or six additional, Rape-seed was sown to cover the ground, and give feeding for the sheep; and all over that field the result of storing 1st of this month just gave the same result as to tonnage as No. 1. The foliage in this field was immense, but the roots are not half the usual size.

"The next field should have been all Potatoes, but only half of it was planted, 10 acres; the other half was made yellow Turnips for sheep-folding, and it was in that 10-acre lot I first discovered the enemy. We left this field on the Tuesday evening, and were two days absent in stackyard; I went back to it on the Friday morning, and found it a wreck. Shortly, there, after it was mostly harrowed level and resown, as a test, perhaps three acres were left where the best plants were; but the result was that Rape-seed was broadcasted over the whole 10 acres, and the sheep have just left the field after a safe and satisfactory sojourn of four weeks of 330 hoggets. We carted off perhaps 40 single horse-loads of roots where we thought there was too much feed; that field is fine, natural, friable loam, and used to grow very heavy roots.

"Still a fourth case, where 10 acres of Oats perished by the long drought, and the cattle and sheep were folded over it; these ploughed and made fine, and dressed with 5 cwt. per acre of super., bone-meal, and nitre. These were thinned, but never got farther; drought and moth cleared the lot, all except two acres. We then sowed Rape-seed, but it was late, the land a yellow clay-loam, the autumn cold, and wet; it did not get up so rich feeding as the other fields. None of them were extra dressed; they were all dunged heavily, 20 to 30 tons muck per acre, and from 4 to 6 cwt. of my compound sown with the seed."

Summary of the above by Mr. Swan.—"You will note I have no light to throw on extra dressing after the moth had been, or whilst still in force, in the field; and, so far as my observation goes, nowhere has much or any return been obtained from it, if the land was dunged and dressed at seeding. I think my reseeding and Rape-seeding has done better for both the condition of the land and the feeding of the sheep. I can only say that in 50 years' actual practice the Diamond-back has hit the heaviest blow I have experienced."—J. S.

Estate Office, Haddo House, Aberdeen, N.B. From Mr. George Muirhead, Agent for the Earl of Aberdeen, with specimens accompanying of caterpillars of Diamond-back Moth, some spun up. Mr. Muirhead wrote that he was sending a young Turnip with specimens of caterpillars found on its leaves, and on those of adjoining Turnip plants, and desired to know whether the insects were of the same species which were destroying the crops in various parts of the country:—

"The Turnips were first showed to be affected by the insects about two days ago; and five or six acres of the field in which they first appeared have been completely eaten up, so far as the leaves are concerned."

Replies to inquiries in circular (see p. 110), August 24th:—

(1). "No reliable estimate can be given. The damage done by the caterpillar is much greater in some localities than in others. Much loss has been suffered in the vicinity of Udny Village.

(2). "No measures were adopted. One proprietor purchased a Strawsonizer with the view of applying superphosphate, but before he got it used the heavy rains cleared off the caterpillars.

(3). "The benefit of heavy rains was so great that no further measures were needed to get rid of the caterpillars.

(4). "Light brown sandy loam. Autumn cultivated; ploughed about seven or eight inches deep. Manures—bone meal, superphospate and slag; no salt.

(5). "Weather and weeds as usual. Weather was dry at seed-time of Turnips.

(6). "The caterpillars were observed to frequent Charlock.

(7). "No birds were observed to be eating the caterpillars."—G. M.

On the 7th of January, in the present year, 1892, Mr. Geo. Muirhead, writing from the Estate Office, Haddo House, Aberdeen, kindly favoured me with the following information in reply to my inquiries as to ultimate extent of injury from caterpillar attack:—

"So far as my own observation has gone, it has appeared to me that where the moth caterpillars had done much damage to the leaves of the young Turnips they never recovered from its effects; and where the foliage was only partially destroyed the diminished crop showed that the constitution of the plants had been injured. On many farms in this district, if not on all, the Turnip crop this season is considerably below the average, the result it is thought of unfavourable weather generally, combined in certain localities with the attack of the caterpillars of the Diamond-back Moth."—G. M.

To the above Mr. Muirhead added the following communication written on Dec. 29th (1891) by Mr. David Walker, of Coullie, Udny, Aberdeenshire, with the remark:—"I have now the pleasure of enclosing a letter which I have received from one of the principal tenant farmers on the Earl of Aberdeen's estates, on the subject of your inquiry." It will be noticed that Mr. Walker especially draws attention to the large amount of "double-tops" or shaws, which is a point incidentally mentioned by various other correspondents as one of the objectionable consequences of attack.

Mr. Walker communicated as follows:—"On account of the very dry weather experienced after sowing, the *late* Turnips on this farm are not a full crop. At the same time, I have never had a crop that made more progress at the end of the year. The cause of this is, no doubt, the exceptionally favourable weather that obtained from harvest to the 22nd of Dec., when the ploughs were locked out by frost. Examining the Turnips to-day, I find they have stood the week's frost admirably, and seem, in every way, not a whit the worse for the moth's unwelcome attentions.

"As far as I have seen, the field in this neighbourhood that suffered most from the ravages of the Diamond-back Moth, is one on the farm of Denend, which lies alongside one of mine. At the side of the field earliest sown, and most damaged by the caterpillar, the bulbs are large, and the leafage fairly luxuriant. The Turnips comprised two varieties, purple and green-topped yellows, and I noticed that while only a normal amount of the former were 'double-shawed,' an abnormally large number of the latter displayed this objectionable profusion of leafage. I may mention here that Mr. T. H. Gibson, Cultercullen, had a field rather severely eaten, and he complains of double-tops, but says that otherwise the crop is a good one.

"The other side of the field at Denend may present a point of interest on account of its having been sown about the same time as my field beside it, and having received treatment by top-dressing,* while mine got no manure except what was put in when the crop was sown. The plants in my field are thicker on the ground and of more equal size, and were so from the first.

"Keeping this in view, the chief difference between the two fields is that in the one which got the dressing, the *crown* of the leafage is large and vigorous, but the bulbs lack size and that roundness of form which indicates maturity; while in the other field the foliage is less vigorous, and the bulbs somewhat larger and much plumper in shape. In my opinion, the top-dressing, while a decided advantage to the early-sown Turnips, has proved of little use to the late."—D. W.

Auchnabo, Slains, Ellon, Aberdeen, August 3rd. From Mr. James Harper, with specimens of Diamond-back attack sent a few days later. Mr. Harper, after noting his success this year in lessening amount of Eel-worm attack in his Oat crop, continued:—"I have apparently got out of one pest, but am into another, namely, the Turnip caterpillar; it has done me extraordinary harm. I have been trying all likely things to get the pest checked, but nothing has done so much good as the weather; we have had a severe storm of wind and rain from the north, and the pest has almost disappeared. The insects are so secure below the Turnip blades, that nothing I have tried can get at them; if it had not been for the weather my crop would have been all useless and destroyed."

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* P.S.—The top-dressing referred to above consisted of 1 cwt. nitrate of soda applied when the moth had done its worst. The varieties of Turnips mentioned were grown from bought seed and mixed before sowing.—D. W.

Replies to inquiries in circular (see p. 110), August 11th:—

(1). "24 acres more or less destroyed; about 10 acres totally destroyed, to the value of £100; the other 14 acres would be destroyed to about £3 to £5 per acre.

(2). "Tried hot lime, also paraffin, soot, &c. None of them appear to do good, as the caterpillars are fairly secured below the leaves. Scuffling destroys them very much.

(3). "I have no doubt the weather does more to check the attack than anything you can do. We had a week of very stormy weather, and it almost cleared the plants (as you will see by the enclosed).

(4). "Good black land, and in good heart, is free from attack. Heavy clay land is destroyed a good bit, especially where it is of any wet nature. Light mossy land, with a little gravel through it, is entirely destroyed; nothing left but a few stumps. Manure used—about 20 square yards of good farmyard dung, with about 10 cwt. manure composed of three parts of dissolved bones; three superphosphate; three sulphate of potash, and one of nitrate of soda. The land was heavily ploughed.

(5). "The weather was observably wet in previous autumn, but had no weeds to clean, so the weeds could have nothing to do with the attack.

(6). "This is undoubtedly the same caterpillar that frequents Charlock. I have carefully examined it, both with the naked eye and also with a magnifying glass.

(7). "I have noticed the Crow paying particular attention to the worst parts of the fields, so I shot one of them to see what it had in its crop, and found it nearly full of the caterpillars, *hundreds* of them."

LANARKSHIRE.—*Newton Farm, Newton, Glasgow, N.B.*, August 11th. From Mr. John Speir.

Replies to inquiries in circular (see p. 110):—

(1). "Loss in my locality is comparatively trifling; practically speaking *nil*. Most crops of Swedes contain a few caterpillars, but damage has been confined to very small patches or holes in the leaves; entire stripping of the leaves being very exceptional.

(2). "I am inclined to recommend Paris-green applied by the knapsack.*

(5). "Previous autumn was very wet. The land was cleaned in spring without any difficulty; and no particular weed was noticeable.

(6). "I cannot say that the caterpillar is specially found to frequent Charlock, as I have little of it.

(7). "I cannot speak of any birds being useful, as the caterpillars are too few for the birds to be making a special raid on them."

ARGYLLSHIRE.—*Inner Hebrides, Foreland House, Island of Islay, N.B.*, August 11th. From Mr. R. Scot Skirving.—"I have to-day seen a local farmer, and he says it has rapidly spread over the whole Island of Islay, its ravages being very severe in some places, and very slight in others. All I have personally seen are near the sea-board of the Atlantic, and it is certainly *worst* there.

"There *is* Charlock (yellow weed, wild Mustard) in Islay, but you may drive a summer's day and not see a specimen, so *that* plant, I may say, has nothing to do with appearance of the grub.

"However, I am informed that recent heavy rains have done much good, and *as a whole* the promise of the Turnip crop in the island is a very good one.

"Though in pretty near neighbourhood to an infested district, no trace of the grub has been seen about this house, either in a patch of Swedes or in the garden."

Two days later (that is, on the 13th of August), Mr. Scot Skirving forwarded me specimens of Turnip leaves, together with cocoons and caterpillars of the Diamond-back Moth, with the observations:—"They are taken from a field near here on my own shooting, but this property has not been much affected, and as rain has at last come (after months of drought) I don't think the crops will suffer. There is a farm some ten miles from here where, I understand, very great damage has been done, acres of Turnips being totally cleared off."

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* The application of Paris-green and flour (one part of the former to fifty of the latter) dusted on the Cabbages when the caterpillars appear early in the season *before the Cabbage head begins to form*, has been suggested in Canada. And the application is also suggested (with directions) for Turnip leafage. But whatever benefit might result where such applications, whether in the form of spray or dry powder, were carried on under careful superintendence, the risk (at least until the use of Paris-green, *i. e.*, arsenite of copper, is better established and understood in this country) appears to me to be so very great in the case of leafage to be used as food, that I fairly *dare not advise* it.

In orchard use, where the poison is given in excessively weak form, and as spray long before the fruit is in more than embryo state, there is no risk at all of poisoning the eaters. But where the poison is to be applied to leafage of food plants, and it is wholly at the discretion of the owner whether it is given at a date ensuring safety to human Cabbage eaters, or with regard to stock the frequent chance of an open gate, or a gap in a hedge, might by possibility cause loss or injury to valuable sheep, I cannot take on myself to *advise* the application.

If, however, any agriculturist wishes for information on the subject, and will write to me thereon, I will furnish him with details.—ED.

On the 25th of August, Mr. Scot Skirving kindly forwarded to me two letters written to Mr. J. S. Ballingal, of Eallabus, Islay, in reply to his inquiries regarding appearance of the pest, which two communications I append below.

Mr. Thos. Fraser, writing from Ardfin, Island of Jura, by Greenock, N.B., communicated as follows regarding Diamond-back Moth or caterpillar:—"It came on our Turnips (at least we observed it) the last days of July. For the first few days we were a little anxious. The crop was well forward, and as soon as the rain and cool weather came the pest grew weaker, so much so that we do not apprehend any serious damage from it for this season. I observe that the moth is decaying or dying in the first stage now. No doubt the result of the heavy rain we had recently."

Islay and Jura are islands of the Inner Hebrides, Co. Arygle; Jura, which is considerably the smaller of the two, lying north-east of Islay, and separated from it by a channel (approximately) somewhere about a couple of miles wide. It is mentioned in Keith Johnston's 'Gazetteer' that the estimated area of this island is about 84 square miles, or 58,400 Scotch acres, only five hundred of which are arable."

The other communication was from Mr. William Rounsfell, written on August 19th from Persabus, Island of Islay, the locality being one mile from Port Askaig which is on the eastern shore of Islay. In this case it will be observed that the caterpillars had passed away, but the description of the white appearance of the injured leafage coincides with that of the muslined or laceworked appearance given elsewhere:—

"I have not seen the caterpillar on the Turnips yet. My own Turnips looked so fresh that I never thought of examining them till I noticed R. McGeachy's, and especially those on the next farm near the Eoralus March dike, which are the worst I have seen, the leaves being white in some parts of the field. I then looked over my own, and saw the leaves holed also to some extent, but there was no caterpillar to be seen.

"I have seen a yard or two near the head-rigs covered with them occasionally in former seasons, but never over a whole field. They were delicately light green caterpillars, which a little rain would wash off."

IRELAND.

The first information I received of presence of the Diamond-back attack in Ireland was conveyed to me on August 14th by Mr. John H. Franks, Secretary of the Irish Land Commission, Dublin, who observed incidentally in a letter on some other business,—"You may be interested to know that the Diamond-back Moth has appeared in many places in Ireland, especially along the eastern coast."

A few days after, on August 17th, specimens of Swede leaves from Dunany, Dunleer, Co. Louth, were sent me by the Editor of the 'Farmer's Gazette,' Dublin, for examination. These showed unmistakable signs of Diamond-back caterpillar ravage; and characteristic cocoons were also sent, but the caterpillars were too much injured to be quite surely recognisable. I therefore requested further supply of specimens, and on August 22nd was favoured by Mr. W. J. Bloomer, Land Steward, Dunany, Dunleer, Co. Louth, with excellent specimens, both in caterpillar and chrysalis state, of the Diamond-back attack, with the following note:—

"I am requested by the Editor of the 'Farmer's Gazette' to send you box with a small quantity of the moths, supposed to be the Diamond-back Moth, which have done so much damage to my Turnip crop this season, but am happy to say the worst is over, as the heavy rain of the past ten days (which was the heaviest rain I have experienced for a great number of years) did a good deal to stamp out the pest; for had the weather continued dry up to now, I wouldn't have had a Turnip left in the field; and especially the younger ones, a great number of which were completely devoured, where the stronger ones only suffered from small holes through the leaves.

"I am happy to say that, after the heavy rain yesterday, it took some time this morning to collect the small quantity sent you. My Turnip field is only a short distance from the sea, where it seems we have suffered most, as I was speaking to some farmers from the midland counties of the north, but they don't seem to know anything about the little moth they have heard so much talk about.

"I tried the experiment of the small knapsack spraying machine; paraffin oil and soft-soap, under the direction of Commissioner Wrench, Irish Land Commission Department, which, I believe, had a good effect, but with the heavy rain at the same time, I hardly know which to give the most credit to. I am thinking if another season brings down the army of little diamond vipers upon us, I will try to fight them in this way:—I will get a hose attached to my water-cart, and continue to dash the water over the Turnips in the form of a heavy shower; this I will continue until all the moths are washed off, same as I see the heavy rain has done in the present case."

The above notes, it will be seen, coincide with the main points of the English and Scotch observations. The attack appeared near the sea-coast, was most injurious to the weakest plants, and its effects were best checked by heavy rains. Probably Mr. Bloomer's simple plan of dashing water at the plants by means of a hose would be thoroughly serviceable.

I had also a communication sent me by Mr. Champion Russell (of Stubbers, Romford, Essex) whilst at Brockley Park, Stradbally, Queen's Co., Ireland, in which he mentioned that there had been some Turnip caterpillar attack, probably Diamond-back; but that the Swedes in which they were appeared to have out-grown the attack. At the date of observation (August 30th), Mr. Champion Russell mentioned that most of the moths had developed and taken wing, and there were many empty cases. A few cocoons were sent to me, which enabled me to identify the attack with certainty from the moth, as being that of Diamond-back. The above note records the most westerly locality of observation of which report was sent me.

Appearance of moths in great numbers at various localities on the eastern coast about the end of June, and considerations pointing to the probability of the infestations having been blown across the ocean from the Continent.

On August 4th Mr. John E. Robson, of Hartlepool, Fellow of the Entomological Society, and Editor of the 'British Naturalist,' described, in a letter sent by him to the 'Newcastle Daily Journal' (published on August 6th), the enormous quantity of the *Plutella cruciferarum*, or Diamond-back Moth, which had suddenly appeared at Hartlepool on June 24th, together with some other points which, coming from a skilled entomologist, used to identify species and observe habits, were very valuable, as they proved almost beyond possibility of doubt that these vast numbers of moths were not developed on land, but had been wind-borne from the continent of Europe.

On application to Mr. John Robson he was good enough to write me more in detail as follows: "As stated in the letter, I was collecting at a little distance from the coast on the evening of June 24th. On my return home my son gave me a specimen which he had caught in the tennis court, and he described the numbers there as being beyond all he had seen before. They were everywhere and in large numbers. At night I crossed the 'coal staiths' for a short cut, to where I wanted to collect; they were there in thousands,—sitting on every coal waggon, on every bit of iron railway plate, on the wooden palings, and rising like a cloud at every step."

Here Mr. Robson gave me long details as to what kinds of plants grew in the neighbourhood (where there were any at all), and of amount of town land, showing that it was absolutely impossible that the moths should have been bred where they appeared.

The moths, Mr. Robson observed, appeared on June 24th, and did not increase in numbers, but in unsuitable places, such as Hartlepool, they disappeared in two or three days, whilst further away a very small number remained on the coast-edge, but they gradually spread inland.

In his published letter Mr. Robson shows something of rate of progress by mentioning that on the day of appearance at Hartlepool he found none at Hezleden Dene, about one and a half miles from the coast, and on June 26th they were swarming at this locality, having penetrated thus far in two days.

Mr. Robson also brought forward the further considerations: "(1) For a long time previous to June 24th easterly winds prevailed, which would greatly assist the moths in crossing the sea. (2) The impossibility of so large a number of the insects passing through the larval stage without being observed by either farmers, gardeners, or entomologists. (3) Their appearance in such abundance in places like Hartlepool, where there is no food at all for the larvæ. (4) The fact that their ravages were confined to the sea-coast or to a restricted distance therefrom. (5) The fact that on June 24th the species appeared simultaneously in many places."

Mr. J. Burdon Sanderson, of Waren, Belford, about two miles from the coast of Northumberland, wrote me as follows: "My own opinion is that the moth came from abroad somehow or other, as the easterly winds were blowing steadily for some weeks, and the attack seemed to be along the coast and up the Tweed. Whether this is possible or not, I do not know. My brother-in-law at Chatton, seven miles inland from Waren, saw an immense quantity of dead moths along the road extending for some half-mile, evidently killed by a heavy shower which had just fallen. This happened just before the attack was noticed, and nothing was thought of what was to follow. Since writing the above, I have just heard that on the night of July 9th an immense cloud of Diamond-back Moths alighted on the Longstone, the farthest of the Farnes, some five miles out to sea; this is on perfectly reliable authority, and seems to favour the theory that they come from abroad."

This appearance of Diamond-back is confirmed by published information from Mr. H. A. Paynter, Solicitor, Alnwick, who mentioned that, being requested by Lord Walsingham to try to get him some moths, he, Mr. Paynter, proceeded on July 10th to the Longstone Lighthouse on the Farne Islands, where he found the rocks close to the lighthouse covered with them. The lighthouse keepers informed him that on the previous night such a great cloud of moths was driven over by the north-east wind that they were obliged to keep sweeping them off the lantern throughout the night in order to allow the light to be seen at sea. Mr. Paynter sent some of these moths to Lord Walsingham (who, it may be remarked in passing, is a highly skilled entomologist), who identified them as Diamond-backs.

The chief points of the above appeared in various papers. I quote from the 'Agricultural Gazette' for August 24th, 1891.

Mr. Fenwick Wilson, of Marden, Whitley, also not far from the Northumbrian coast, mentioned: "A common opinion exists in this neighbourhood that the moth crossed over from the Continent. Some fishermen I have spoken to say that about the end of June moths were about the shores in enormous quantities, and were spoken of by them at that time. If it is possible for them to come from abroad that very much supports the theory."

Further north still the observation of a vast appearance of moths on the seacoast was thus reported by Mr. Balsillie, of St. Andrews, Fife: "On the last days of June an extraordinary number of small greyish-brown moths were observed all along the eastern seaboard of the county of Fife infesting the Turnip-fields. Their appearance was coincident with a long-continued drought, and though the plants had brairded, they were making exceedingly little progress. On Monday, July 20th, or as nearly as may be three weeks after the appearance of the moths, both Swede and yellow Turnips presented the appearance as if lime had been sown on them. On looking more particularly, it was found that the plants were infested with small green caterpillars, which had eaten the underside of the blade, leaving the thin film on the upper surface. In this way whole fields were destroyed. In other cases portions of a field seemed to escape with little damage."

Some reference to first observations of appearance of moths preceding outbreak of attack will also be found amongst the observations of contributors, and some further notes on the subject in the following summary.

GENERAL SUMMARY.

In the foregoing records of observations, it will be seen that I have given scarcely any which were not accompanied by specimens, so as to enable me to identify the attack.

With many kinds of crop attacks there is no difficulty in any observer, who has once been shown the characteristics, knowing perfectly what is going on; but, as there are several kinds of green caterpillars that feed on Turnip leafage, and, in this instance, the leaves attacked by no means, in all cases, showed only the "laced work" or "muslined" appearance, which is characteristic of Diamond-back infestation, where the upper cuticle of the leaf still remains but partially injured, it is necessary in working it out to any definite purpose to be sure what we have in hand.

This is particularly the case with regard to distinction between attack of caterpillars of the Diamond-back Moth and those of the Turnip Sawfly, which were also present in the past season, notably near Ulceby, in Lincolnshire, and of which Mr. Frankish (of Limber, Ulceby), who is perfectly qualified to judge on the subject, wrote me (see note, p. 116) in reply to my inquiries, "It would be perfectly impossible for us, or any one, to separate the damage caused by the different caterpillars."

Remedies which would act easily and promptly on the Sawfly caterpillar would be very likely to have little or no effect on that of the Diamond-back; therefore, in order to be certain of what we are dealing with, I have given (with hardly any exceptions) only observations of contributors who sent me specimens;* and readers who wish to collate the notes given may easily do so by turning the pages so as to take the information given by the different observers under the various numbers of the "replies to inquiries in circular," and comparing these points (or those following and preceding with regard to accounts of first attack and ultimate results).

The great singularity of the attack consisted in the very sudden outburst of the infestation of an insect (which has long been known to be fairly common and abundant amongst Turnips and Cabbages) taking place *not* as might have been expected over inland and coastland indifferently, where these crops are generally grown, and their favourite weed plants found; but for the most part, and also most destructively and markedly, on a strip of coastland running the greater part of the length of the east seaboard of England and Scotland.

Difference of opinion appears to exist as to whether the infestation was home-bred or wind-borne from other countries. So far as is shown by the evidence given *it appears to me to have been wind-borne.*

By examination of the notes given under the head of "Appearance of Moths," pp. 155 —157, it will be seen that great numbers of these were noticed at various localities, coincidently with observation of easterly winds, and that these having been observed at the shores or outside the shores (and in various cases proved to be Diamond-backs by examination of specimens, or by the attack that followed their presence being of Diamond-back caterpillar), that the infestation spread inland.

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* A few will also be found from contributors who appeared to be qualified to judge of what was present, and in the quotations I was permitted by favour of the Editor to make from the 'Alnwick Guardian' I have given the notes of the Northumbrian observers to *presence;* but I have given little or nothing broadscale, hearsay or reminiscence, for fear of *measures*, should they again be wanted in haste, not being found to stand the test.

It has been objected to this view that it is quite possible that the quantities of moths seen at Hartlepool, and at the Farne Islands, "came from neighbouring localities inland, attracted by the lights of the lighthouses." * It does not, however, appear to me that such could be the case, because on writing to Mr. John E. Robson, Fellow of the Entomological Society, who had recorded the Hartlepool attack with great care, he replied:—"Hartlepool lighthouse stands at the end of a promontory, but shines no light to land within many miles. Across the bay to the Cleveland Hills is the nearest, perhaps twelve miles away." Also on applying further for information on this matter to Mr. W. Belk, Engineer to the Port and Harbour Commissioners, Hartlepool, he favoured me by writing as follows:—"Relatively to moths, &c., appearing at this place on or about June the 24th, I am of your opinion that it would have been almost impossible that the lighthouse here could have caused the attraction, as the light is obscured one-third to the landward, and bright two-thirds to the sea." —W. B.

Also it is to be observed with regard to direction of progress, that Mr. Robson, though collecting (entomologically) inland on the 24th of June, noticed none of these moths at the locality Hezleden Dene, about one and a half miles from the coast, and on returning to Hartlepool found them in vast numbers. They disappeared almost entirely from Hartlepool in two or three days, and on the 26th were swarming at the inland locality Hezleden Dene, where they were known to be absent two days before. In regard to the Farnes (that the cloud of moths was driven by the N.E. wind), see line 2, p. 157; and we have also notes of the inland progress. And again, looking at coincidences further north it is of interest to note that the direction of the wind at Leith at 8 a.m. on twenty of the thirty days of June (as given in the daily weather report issued by the Meteorological Office), was E.; E.N.E., or N.E.; which prevalence may have borne much on the great amount of attack in Fifeshire, over which county and along which seaboard the N.E. wind would especially sweep.

The matter of the wherefrom of the pests is of so much importance practically, that it seems worth while to go into it so far as is possible. Amongst all the reports sent me there is no local evidence of the attack being home-bred. If such had been the case, it might on all general

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* See Report of the Intelligence Department (Board of Agriculture) on "Attack of the Diamond-back Moth caterpillar in 1891," p. 20.

principles have been expected to be distributed over the country where its food-plants are mostly distributed. But if by any strange and unaccountable chance it had only been bred along the coast, it is almost impossible that the ravages of the myriads of caterpillars which must have forestalled the moths to which they presently developed should have escaped observation. It will also be seen by collating the "replies to inquiries" (Nos. 5 and 6), that for the most part there had been no particular weed observed, nor special presence of Charlock, nor difficulties in proper cultivation of the land.

The *crop food-plants*, whether field or garden, are of kinds to be found in all cultivated districts; and of *the weed food-plants*, as Charlock, Jack-by-the-hedge, Flix-weed, and others named *on good authority* as frequented by the pest, I only find two which occur (respectively), one ordinarily, one exceptionally, on the sea-shore.

Of these, one, the *Diplotaxis tenuifolia* (the narrow-leaved Wall Mustard or Wall Rocket), occurs in England by roadsides or on old walls; in Scotland it is recorded as not being found further north than Fifeshire, and occurring on the ballast hills at St. David's on the Firth of Forth. The other, the *Salsola kali*, or Saltwort, is found on sea-shores.*

In any case, however, as to this, it appears to me that such a very small proportion of the food-plants of which we have notes *on any sort of authority* are sea-side plants, that we have no reason here which explains a prevalence upon this one sole occasion on record of an extraordinary amount of outburst along our eastern coast.

At first the caterpillar ravage threatened to sweep all before it, and was variously reported as having entirely "destroyed" crops under observation; as "making havoc," "devastating the fields"; "brutes eating all in front of them"; "likely to be most disastrous to agriculturists"; causing destruction to hundreds of acres, &c., and naturally wide-spread uneasiness arose. This was enhanced by the destruction being so rapid. In this case, as with many other kinds of crop attack, the damage being little observable until "the brutes" have their eating powers well developed, the rapidity of the after progress is all the more remarkable; the myriads of nearly full grown eaters make way quickly.

The rapidity of the devastation was noticed by Mr. Garrett Taylor

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* This is given by Dr. E. L. Taschenberg (in his 'Praktische Insekten-Kunde') as a food-plant of the Diamond-back caterpillar, and on his excellent authority I have repeated the statement in some of my publications; but I have not received any reports of caterpillar presence on this plant, and am informed by Mr. Atmore, of King's Lynn, that in his investigations on the shore where both Saltwort and Diamond-back Moths were present, that he has not seen that the caterpillar was present on the plant.—Ed.

(p. 120), as being as if a swarm of locusts had come. Near Carnoustie, Co. Forfar (p. 146), three days or less sufficed to wreck the leafage of all the plants in a ten-acre field. At Gunsgreen, Eyemouth, Berwickshire (p. 184), a promising crop was in ten days irrecoverably ruined, and similar damage reported on neighbouring farms.

Under these circumstances all that it appeared to me possible to do in reply to the many applications which were sent to me, officially or otherwise, was to place information immediately before all inquirers regarding the well-known history and habits of the insects, and also notes of such measures as had been found useful on previous, though not such urgent, emergencies. How far these or other means would have proved serviceable without the succeeding rainfalls, cannot be told; probably the use of the scufflers would have been beneficial, and the dressings been almost useless.

As it was, the following rains appear, by the various effects of the heavy downpour, to have been the saving of the crops. The rainfall was noted in many of the reports as not merely ordinary rain, but often as heavy, also as "very heavy rain and thunder showers"; and in one instance it is noted, "Heavy rains (1·78 in. and 2 in.) have done immense good, and caterpillar gone. Rain with wind is noted as especially beneficial."

Part of the benefit would be direct by lessening the amount of caterpillars, as these would be thrown open to action of the rain when accompanied by wind; part, as noted by various correspondents, by the sand and mud being dashed up and thus "soiling" the under side of the leaves, and making it rather difficult for the caterpillars to work, and a very large proportion of good would be done by the injured plants being thrown into growth again, and the food stores in the ground, or in the stimulating dressings, being made available by the moisture.

Amongst the dry dressings most especially mentioned as beneficial, nitrate of soda stands first, *not as killing the caterpillars*, but as throwing the plants into renewed growth. The following mixture was found useful at Edenthorpe (p. 118), 10 cwt. soot, 8 cwt. nitrate of soda, and 1 cwt. sulphate of ammonia, mixed well and sown broadcast by hand whilst the *dew* was on the leaves, at the rate of 1 cwt. per acre.

Nitrate of soda and salt have also been found useful. Proportions found serviceable by Mr. Garrett Taylor (p. 120), were about four stones per acre of each, sown by hand along the drills. Also (same page) Mr. Garrett Taylor noted, "I think the best remedy that has yet been found is a mixture of three-quarters soot and one-quarter lime, and sown on the plants."

Soot was found useful in clearing the caterpillars when thrown so as to adhere to the under side of the leafage. At p. 125 the method is described as,—" Soot applied, August 6th, at the rate of 2 cwt. per acre, sown by hand one drill at a time, the sower stooping a little and keeping his hand low at the delivery." Here, however (as well as with other of the dry dressings), it is to be borne in mind that one great point of serviceableness is the effect on the plant as a manure; and where the caterpillars are only caused to fall, there may be need for mechanical measures to bury them (see above reference, p. 125).

Superphosphate is mentioned (slightly) as of use, and lime as not of use, though quicklime applied by hand when a strong wind was blowing along the drills, so that it was carried well to the under side of the leaves, was considered to do some good by interfering with the working of the caterpillars.

For spraying or wet dressings, four to six gallons of paraffin per acre, applied by the Strawsonizer, is mentioned by Mr. Garrett Taylor (p. 120) as having answered very well. A mixture of soft-soap and paraffin, in the proportion of 5 lbs. of the former and 5 pints of the latter to 100 gallons of water, was found to destroy the caterpillars on Cabbage leaves.

With regard to mechanical measures, " continued scuffling, or in any way brushing the land about, has been beneficial." On page 111, it is mentioned,—" The method I found to answer best, and the least cost, was using a thorn bough attached in front, and set so as to turn the leaves completely over; by so doing it broke the webs and let the caterpillars down, and the scuffler buried them." Page 117, " All the remedy I made use of was to keep going all the horse-hoes and scufflers I had all day long." Page 140:—" Several farmers have put in boughs of trees in the scufflers. I put in my ploughs a good firm bundle of Wheat straw, bent down at the ends so as to rub the under part of the leaves without damaging them, as the boughs are apt to do." Whether, however, by means of ploughs, or horse-hoes, or scufflers, mechanical measures of disturbance suitable for making the caterpillars throw themselves down by their threads, and then burying them, have been found of much service. But in this attack the injury, when once it has reached the point at which it is noticeable, is carried on with such devastating rapidity that it is of vital importance to the crop to act at once. On this account (though it may reasonably be hoped that an attack which has only been recorded as troubling us to a serious widespread extent once before, and that about forty years ago, is not likely to be of frequent recurrence) it is to be borne in mind that implements and appliances to be found ready for use on every farm, and common farm manurial and chemical dressings such as are procurable, if not at hand, at the nearest town, are those to be most relied on.

Effects of the attack.—The amount of loss can hardly be reliably estimated, as this depends on many circumstances, besides what is calculable regarding direct deficiency of amount or of condition of the crop. But by collating the replies ("1") in answers to inquiries together, and also the preceding notes of observation of first attack, some idea will be gained of the power of the caterpillars for making rapid and complete work.

Taking just a few of the returns on farms or in districts along the line of ravage which show bad injury at various dates after about the middle of August, we find at a locality in Aberdeenshire (p. 151), 24 acres more or less destroyed; about 10 acres destroyed to the value of £100. Eyemouth, Berwickshire (p. 185), "In all my experience I never saw such a failure." Holbeach Marsh, Lincs. (p. 114), "I consider that 25 per cent. of the Swede crop in this district in acreage is entirely lost or gone, and that 25 per cent. of the whole crop is so injured as to be valueless." Corton, near Lowestoft, Suffolk (p. 121):—"The greater part of the crop was entirely destroyed." These few reports, taken from many, show the power for harm of the caterpillar, and every shade of difference in amount of harm, from slight attack, or sound *bulb-forming* recovery, down to complete clearance, will be found in the notes.

The same differences will be found in such few reports as were contributed of ultimate condition, or of state at the end of the year. They are (as the case may be) of plentiful crop of good bulbs,—this from personal examination by reporter,—or of bulbs lessened in size by attack, or even (see top lines of p. 186, and third and fourth lines from foot p. 148) of very severe loss, or complete failure; this last, however, appears to have been quite exceptional, so far as I can judge from reports sent to myself.

One great feature of the recovering crop was the enormous luxuriance of leafage, often leading to a hope that the bulbing beneath would be satisfactory; another the extra amount of tops; and in one case (p. 126) the altered form of the bulb is mentioned, "the Swedes seem to have been more to neck as well as leaf than usual."

Probably the remarks given under reply to inquiry (4), p. 188, and the remarks on the following page (189), as to effect of unfavourable weather on recovery of bulb-forming powers of the crop, give as good a general sketch of the matter as can be put in a few words.

The attack has not been so utterly disastrous as it was feared might be the case from the severe injuries following on the first observation of its presence; but it has been very mischievous, and so peculiar in many points, that taking it as a whole I am not aware of more than one somewhat similar instance having been *trustworthily* recorded as occurring in this country. There is nothing unexampled in the appearance of vast swarms of Lepidoptera (*i. e.*, of moths and butterflies) which have flown or been wind-borne over sea and wide expanse of land. No better example of this is probably on record here than the enormous appearance of the "Silver Y," or Beet Moth (the *Plusia gamma*), and the Painted Lady Butterfly (*Vanessa cardui*), of which one great detachment crossed the Mediterranean from Africa to Valencia, and another crossed to Sicily in 1879. The progress of these across Europe was noted, especially in Saxony, where the Beet Moth caterpillar ravage reduced the yield of the infested Beet from 9 to 10 tons per acre down to only 3 tons; the first appearance on our south coast being noticed on June 10th.*

There is also a record of an exceedingly similar attack to that of the past season given by Mr. Wm. Marshall in the Transactions of the Royal Society for 1783, vol. lxxiii., p. 217. In this case the attack was of Turnip Sawflies, and the locality the Norfolk coast. The insects were seen out at sea, were found in vast numbers on the coast, and from thence proceeded inland. The young caterpillars were found shortly after present on the Turnip leafage, and the destruction "was not confined to the eastern coast, but spread more or less to the centre of the county."† It is worth observation that presence of caterpillars of Turnip Sawfly was found together with that of Diamond-back Moth caterpillars in one district during our last year's attack (see p. 116).

So far, however, as I am aware the experience of last year, *taking all the points together*, was unexampled here, and therefore, so far as in me lay, I have used my very best endeavours to secure a permanent record, with authorities so fully given, that we may be sure of all details, or may verify any doubtful point by reference, and I offer my hearty thanks to all my correspondents for the care and patience with which they were good enough to reply, sometimes again and again, to my repeated inquiries.

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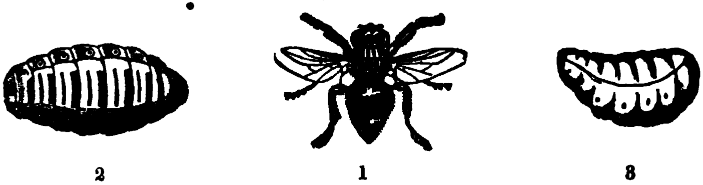
* See pp. 4, 5 of my 'Report on Injurious Insects' for 1879, with details and date of progress of the swarms placed in my hands by Mr. E. A. Fitch, Hon. Sec. of the Entomological Society of London.

† As many (like myself) have not the original paper to refer to, it may be mentioned that extracts, and a few remarks (especially on the perfect possibility of the swarms coming on the wing), will be found in Curtis's 'Farm Insects,' pp. 38—40; and much of the paper is also given by Edward Newman, F.L.S., &c., in Appendix B to his small volume entitled 'Rusticus.'

OX.

Ox Warble. *Hypoderma bovis*, De Geer.



1, Ox Warble Fly; 2, maggot; 3, chrysalis.

The life-history of the Warble Fly, and information regarding measures which have been found to be of reliable service in lessening the heavy losses caused by uncared for presence of its maggots in the hides of our cattle, have now been so repeatedly entered on in these Reports since the year 1884, that we appear to have these parts of the matter as thoroughly in hand as can be needed for practical purposes.

1st. *We have the history of the attack, and of methods of prevention and remedy*, from scientific as well as practical observations of veterinary surgeons, farmers, and cattle-owners, to which relatively to the attack itself I have added the minutest observations I could myself make regarding the development of the maggot, and also of the Warble, from what could be learnt from sections of the hide whilst the maggot was still in what might be described as a microscopic stage, to the conditions observable in the newly flayed hide, or on the carcase from which the hide had been taken.

2nd. *With regard to losses*, we have the testimony of great numbers of those most personally interested in the matter, accompanied by their well-known names, regarding the mischief and losses occurring in all stages of the attack, from the preliminary galloping to loss on hides and carcases; and in my Report for 1888, I give estimates or calculations from many of our leading butchers, hide or cattle firms and associations of England and Scotland, showing the severity of the losses incurred, which, from accompanying trade tables, may be calculated minutely even down to numbers of hides in the special classes, which were "outclassed" in one of our large markets in the year, together with the depreciation in value per hide, and also depreciation per pound.

3rd. *The pressing need of remedy of this state of things* is not only shown by the records of public and private loss, but borne witness to authoritatively in various ways, as by the special arrangements made for exhibition of warbled hides, and dissemination of instruction regarding measures of prevention and remedy given at the shows of our own Royal Agricultural Society; also by the similar attention drawn to the subject in various localities yearly by other societies or large firms connected with the hide and cattle trade, and notably the attention given at the show of the "Royal Dublin" Society in the past winter.

Under these circumstances it would seem to be but waste of space to go over these points again; I add, however, the following note sent me by Mr. W. Bailey, Headmaster of the Aldersey Grammar School, Bunbury, Tarporley, Cheshire, to show how (for all practical purposes) this wasteful infestation may be got rid of throughout a district by no more troublesome or expensive measures than the voluntary work of some of the boys of a country school, under instruction as to what was to be done, and with the willing permission of the farmers of the neighbourhood to allow the lads access to their cattle.

My first report of their work was in 1885 (warbles being then, as previously described, as plentiful as blackberries). It was at first begun under the suggestion and advice of Mr. Bailey the Headmaster, with perhaps some amount of co-operation from myself, and was continued, from the benefit accruing to the cattle, and thence to their owners, with such success, that on Dec. 6th, 1887, an account of their work was read before a Committee at the Royal Agricultural Society, and directed by Council to be published.

The work has since gone on so satisfactorily, that in the past year instead of giving me his customary detailed report Mr. Bailey wrote as follows:—"Although I again granted the boys a roving commission, and no want of diligence was shown in their search, I am glad to tell you that an exceedingly small number of maggots has been discovered. The highest number brought in by any one boy was 23 this year. You will remember that a very few years ago they were as plentiful as blackberries, and that one boy alone (F. Ravenscroft) destroyed nearly 800.

"I believe that now all the farmers in this district very carefully examine their stock for warble maggots, and that although we may not be able to stamp this pest out *completely*, as long as cattle are bought in fairs at some distance from us, it will always be well kept down."

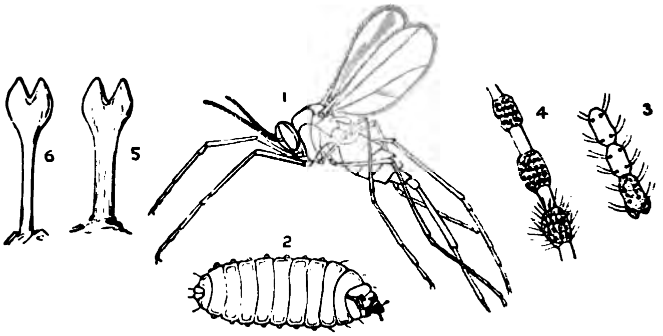
The great obstacle in the way of advance in stamping out this attack is IGNORANCE. It takes a long time to undermine old prejudices, particularly when these agree conveniently with carelessness, idleness, and also with getting off damaged beasts at the price of good ones.

We need to get plain information so well spread, that it may be available for the cattle-men,—as well as for the cattle-owners, and also for working butchers,—that they may know the loss they are likely to suffer from "licked beef" on the carcase of a beast of which the hide is badly warbled. In the present increased attention which is being given to agricultural instruction in rural districts, it would be highly beneficial if this subject could be brought forward, and as before, I should be only too happy to forward copies of my two leaflets respectively on Warble Fly and Licked Beef gratuitously to all applicants who wish for them for practical purposes. Of these the first describes the nature of the attack, with the methods of prevention and remedy which have been found serviceable. Of this about one hundred and twenty-six thousand have been already circulated. The other gives more special information on the nature of the condition of the carcase known as "Licked Beef" or Jelly, as found beneath badly warbled hide. Both leaflets are fully illustrated.

NOTE.

TARE, *Cecidomyia.* At p. 54, reference is given to a paper on Tare Cecids for figure of a *Cecidomyia* showing the "anchor process," or "breast-bone." I have not, however, succeeded in rearing any specimens of the perfect insect (*i. e.*, the *Cecidomyia* or Gnat Midge) from the great number of Tare Cecid maggots which were placed in my hands last summer. Therefore, as I cannot as yet identify the species, and do not like to give an incomplete observation, the figure below is substituted.

This figure of the *Cecidomyia leguminicola*, Lintner, or American Clover-seed Midge, which is sometimes found in England, will give the reader a correct view of the usual form of the maggot of *Cecidomyiæ*, with the anchor process beneath the head end; the anchor process still more magnified, with, in this instance (as in that of the Hop Strig maggot), a bifid extremity; and also a figure of the two-winged Midge-gnat.



CECIDOMYIA LEGUMINICOLA.

1, Clover-seed Midge; 2, maggot; 3, portion of female antenna, with minute hairs figured on lowest joint; 4, portion of male antenna; after Professor Riley; 5, anchor process; after Dr. Lintner; all magnified; 6, anchor process, figured from English specimens, also magnified, by Ed. Nat. length of maggot about one-twelfth of an inch.

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